SEPTEMBER, 1941

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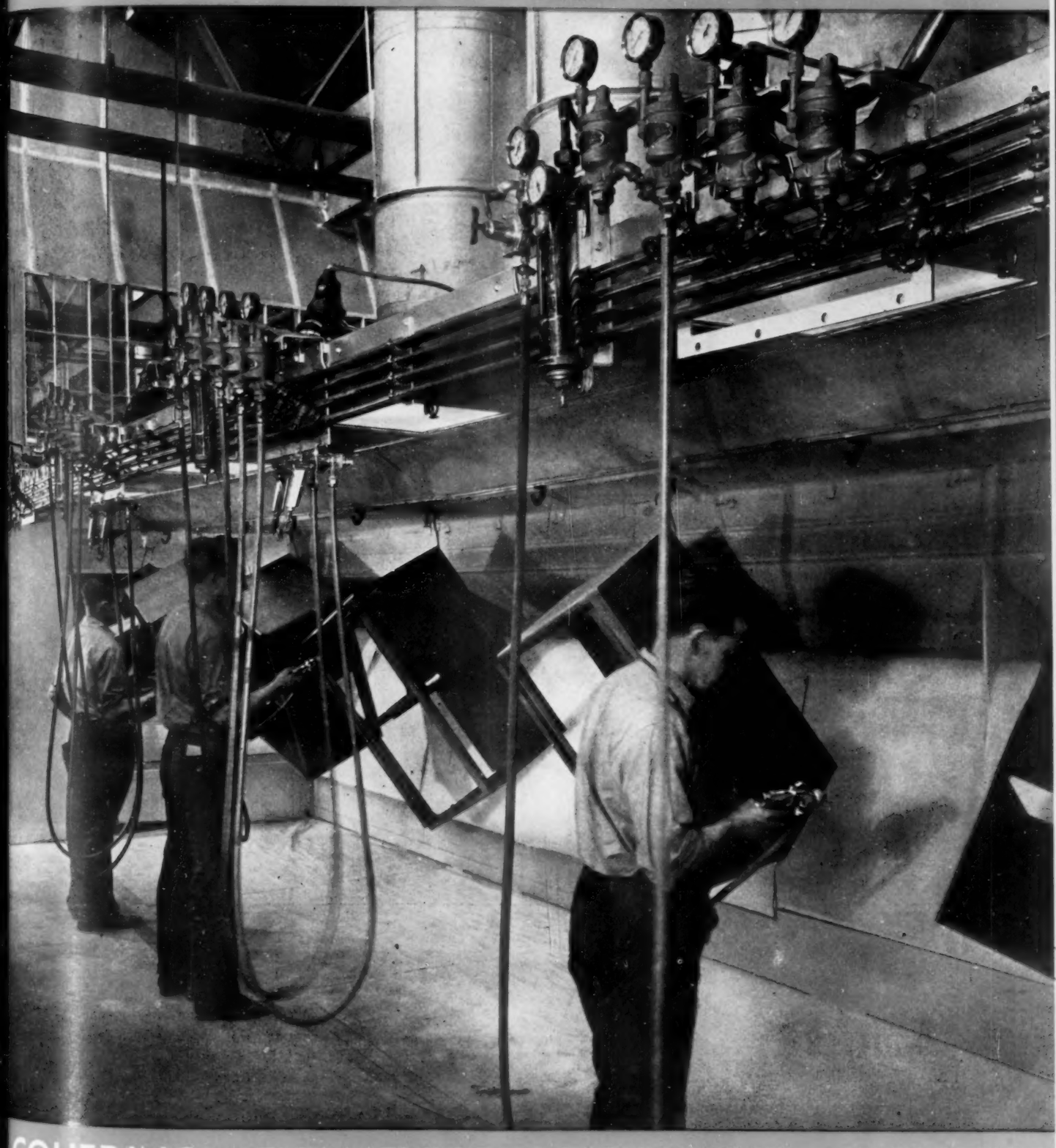

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Save Finishing Materials

All of us in the finishing industry are beginning to appreciate that these days are not the halcyon ones when it was entirely possible to wire a supplier for a finishing material and expect prompt delivery so that production might not be halted. Today, because many of the raw materials of lacquers, enamels, japans and the like are difficult to obtain, and for other reasons, the supplier of your finishing material simply can not deliver the goods in many instances. What can the user of finishing materials do to help the situation. The answer is simple—eliminate waste. Eliminate waste to ease the present tight situation, to give the other fellow and Uncle Sam a break.

Eliminating waste of finishing materials can be accomplished in a number of ways. Some of these are:

1. Keep all containers tightly closed. Not only is the loss of solvent by evaporation an important factor, but many finishing materials deteriorate on standing open to the air, become unfit for use and must be scrapped.

2. Completely empty all containers of finishing materials. Perhaps the best procedure is to wash out the containers with the solvent which is to be used for thinning the particular material.

3. Avoid spilling of finishing materials and thinners.

4. In storing finishing materials, do not expose them to extremes of temperature. Heat or cold can often ruin a finishing material beyond use.

5. Do everything possible to eliminate the causes of rejections which would require refinishing and the use of extra material.

6. Use that finishing method which is most economical of material consistent with good results.

7. Where it is possible, attempt to reclaim finishing materials from spray booths, etc.

Saving finishing materials is not only good economics. It is a cooperative duty. Remember that to the other fellow you are the other fellow. If you save, it will aid him. If, by following your example, he is careful of waste, you will find yourself less pinched and more able to obtain the finishing materials which you need to continue your finishing operations.

L. H. LANGDON, *Publisher* • T. A. TRUMBOUR, *Business Manager* • DR. WALTER R. MEYER, *Editor*

Paint Recovery*

S. G. SAUNDERS
Chrysler Corporation, Detroit, Mich.

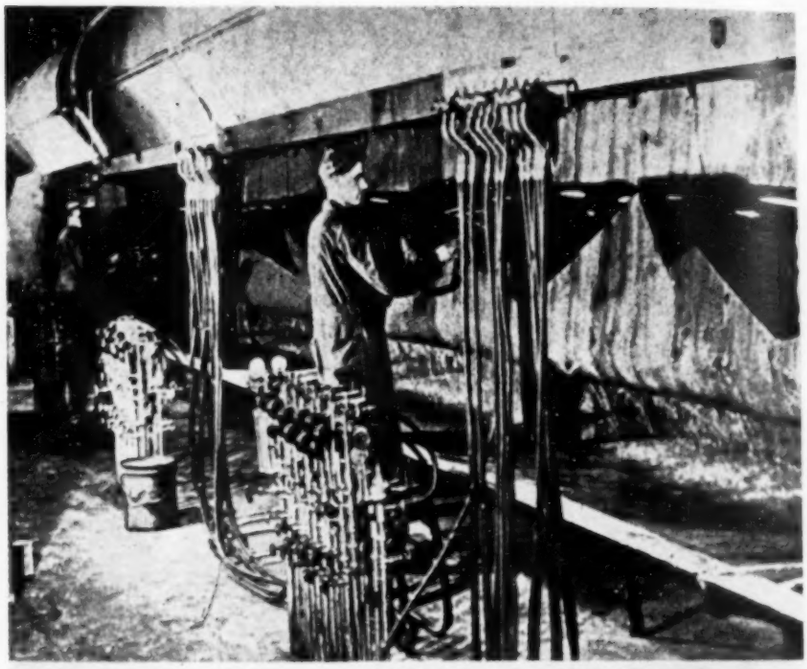
FOR a long time Chrysler Corporation has been interested in the problem of paint recovery and what it would mean in terms of savings and more efficient plant operation. We have carried on extensive experiments, as a result of which a paint recovery system has been developed which gives satisfactory results. The problems which had to be overcome and the steps in the development of the recovery system will be described here.

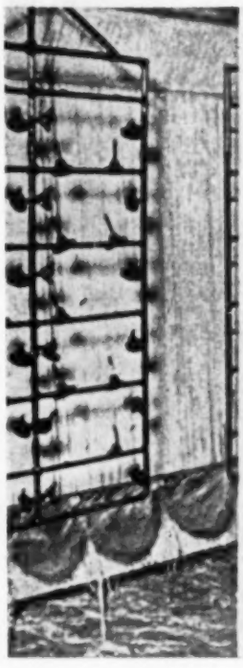
In considering the feasibility of paint recovery from over-spray in water-type spray booths, one question immediately came to mind. It was obvious that many constituents of paint solids are at one time wetted with water, or water is given off or evaporated as a part of the resin cooking operation. Why, then, could not water be removed from the finished product and leave us with the same quality product as in the original manufacture?

The process itself as regards lacquer was relatively simple. Water alone "kicked" the lacquer out of solution. The resulting sludge had no adhesion to walls and pipes and could be collected, dried in a centrifugal dryer, redissolved, and clarified, etc. After reduction with a thinner, from 2 to 3 per cent water remained. Then the thinner had to be altered slightly to obtain the same flow, evaporation rate, etc. Exposure of this material was better than on the new lacquers, but this may have been because of the darker color of recovered material.

The next problem was, where could the recovered lacquer be used advantageously—i.e., to replace new lacquer materials. The following uses were developed: crankcase sealer, underneath fenders and hoods, ground coat where the color was satisfactory, and several jobs using reclaim as the finish coats.

After recovering and using the lacquer for two years we changed to





(Above) A Small-Parts Booth in Operation at Chrysler's DeSoto Plant; Although This Was One of the First Water-Type Spray Booths, It Has Always Operated Successfully, Mainly Owing to Lack of Restrictions in a Circulating System.

(Below) The Type of Small Parts Being Sprayed Is of Such a Nature That the Water Does Not Splash on Them Readily.

*Reprinted from "Industrial and Engineering Chemistry 33, 230 (1941).

alkyd resin enamel finishes on cars. These turned out to be even more troublesome, principally because enamel sludge is sticky.

In trying to keep sludge from sticking, over a period of several years, we have tried at least two hundred different compounds in the wash water. Where recovery is not a factor, alkalies are commonly used in the water medium. Alkali is partially satisfactory from the standpoint of keeping the paint systems clean, but if used in high enough proportion to do this, the sludge is useless from a recovery angle because the alkali saponifies the resins or fatty acids in the sludge.

When enamel sludge was first reclaimed in our plants, water medium was not used. In its place was employed a product known as mineral seal oil, a type of light paraffin oil. This worked almost perfectly, as far as keeping the paint systems clean, but the capillary action of this oil was such that when it condensed in the ducts it tended to drip back on the finished jobs. In addition, the baking schedules of the enamels were not sufficient to get rid of the oil entirely, so that the drying was impaired.

From mineral seal oil we went to soluble oil additions to the water. This oil consisted of a naphthenic acid soap with paraffin oil. The concentration used was 3 per cent in water. Here again the oil left behind (when the sludge was reclaimed) hindered the drying of the enamels under regular baking schedules. Also, the lubrication was rather poor as compared to mineral seal oil and necessitated frequent cleaning of the paint systems.

During another experiment a colloidal graphite dispersion in water was our reclaiming medium. This material was inert and exerted no influence on the resultant enamel reclaimed in regard to drying or other properties. However, the lubricating properties were only fair, the graphite discolored reds, whites, etc., and much work was done trying to find a better product.

Among the various materials tried out as lubricants in conjunction with water mediums were talc, wetting agents, precipitated hydrates on bentonite, and soaps. None of them was very satisfactory for different reasons. Water emulsions of talc, for instance, would work only as a parting compound when the pH was such that the emulsion broke when the water struck the booth curtain walls. Then the talc separated out and was useless. Precipitated hydrates on bentonite were such powerful emulsifying agents that only 1 part of compound to 39,000 parts of water could be used; and at that point the lubricating properties were rather poor.

Soaps worked fairly well, especially the ammonia soaps of naphthenic acids. Here, however, excessive foaming was encountered, and the concentration had to be reduced to such an extent as to lose effectiveness in keeping the systems clean. When used with hard waters, the soaps were precipitated out of solution and were thus useless as lubricants. The same results were obtained with wetting agents. They are all powerful emulsifiers and foamers, but the enamel sludge collected from them was so emulsified as to render the handling and collecting almost impossible.

The product we are using now, Bri-

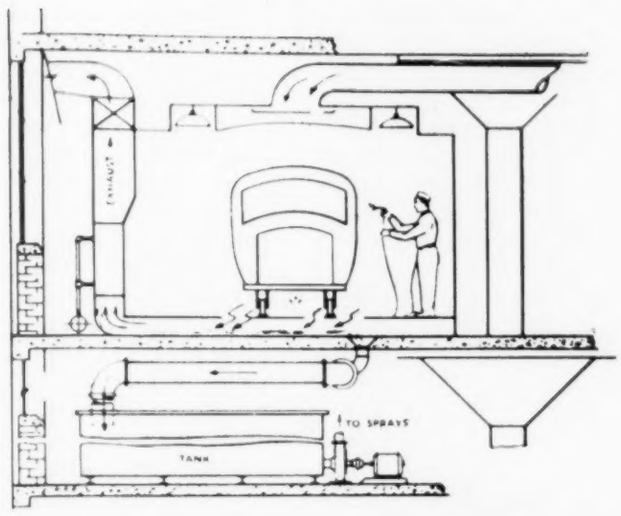


FIGURE 1. EXAMPLE OF A BADLY DESIGNED SPRAY BOOTH, WHICH WAS NEVER MEANT TO HANDLE STICKY "LIVERLIKE" SLUDGE

The water underneath the floor which supports the body and the man is perfectly level, with very little force of movement to the outlet which goes into a horizontal pipe—another bad feature where sludge can drop to the bottom, stick, and build up.

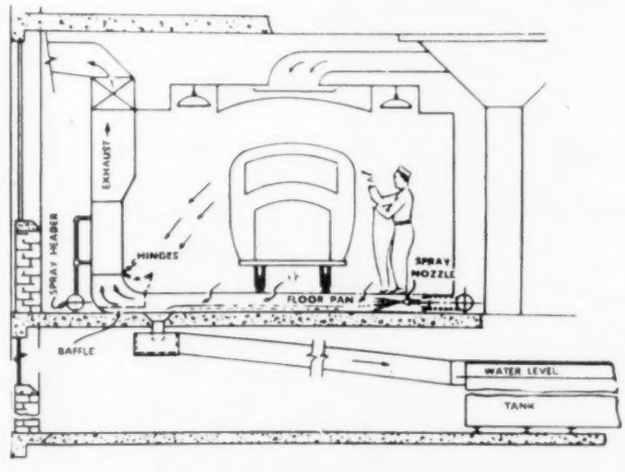


FIGURE 2. ALTERATION OF THE BOOTH IN FIGURE 1 TO ONE OF GOOD DESIGN

Spray nozzles underneath the man are distributing water under force all along the floor pan which has been given a definite slope, although this does not show up in the picture. Every part of this floor plan is wetted with fast-moving water in the form of a curtain. This flows to the other side of the booth and enters a pipe which is sloping all the way to the main collection tank or sludge tank. This kind of booth gives five times as much sludge per week as the booth in Figure 1 and illustrates the amount of material that does not have to be cleaned out from the floor in the booth and in the pipes.

cate, is one of the most fortunate developments in the growth of this entire process. Water alone does not wet the paint particle, and any water film has insufficient film strength to form an envelope around the particle which cannot be ruptured by the pressure of the particle against the wall of the booth or of one particle against another. Therefore, it was necessary to find a method of forming a water film around the paint particle, and to have this water envelope act as a carrier for some material which would either lubricate the paint particle or otherwise prevent it from adhering to the booth surfaces.

Caustic alkalies and some of the salts of the alkaline earth metals and aluminum will form a protecting envelope around the paint particle which will prevent it from sticking to the booth surfaces, but it does this at the expense of the recovered material.

It was desirable then to find a material which had little hiding power so that it would not change the color of the recovered material. Also, it was necessary that the material should remain in suspension for several days and that any settling could be put back in suspension when the water medium was again circulated.

Since no material will stay in colloidal suspension by itself unless it is very small in particle size, some protecting colloid had to be used so that less expensive materials could be utilized for the suspended material. It was necessary that the protecting colloid carry the same particle charge as the charge of the booth surfaces and opposite to that of the suspended material, so that the particles would repel each other and tend to maintain the suspension.

It was also essential that there be no decomposition or other chemical change because of the materials used. Bacterial action causes the formation of gelatinous bodies or "seeds" in the recovered coatings when reused. Since some of the materials are included in the sludge, they should in no way decrease the quality of the recovered paint.

Bricate as now compounded will adhere to the booth surfaces even though water is sprayed against the coating or allowed to run down over it. A very small amount is added to the water used in the booth unit. This material in suspension coats the sludge and causes it to be dry and nonadhesive for a short time or only long enough to get from the booth itself into the large central tank from which it is collected. The coating on the walls and booth surfaces does not decrease or increase in thickness and serves to present a surface when kept wet with water to which paint materials cannot stick. All sumps and conducting pipes are also coated with Bricate.

An example of the efficiency of Bricate occurred in our Dodge plant. The year graphite was used as a lubricant, the pipe lines in one of our sets of booths had to be cleaned with lye and boiling water every two days, a dirty and costly job. With Bricate in the system, lye applications need be only partly applied about every two months. The sludge in the main tank is skimmed off every two or three hours and placed in drums which are then sent to the reclaiming plant.

Bricate is used only on the wet parts of spray booths. Another product had to be developed to replace the soaps or mineral oil types usually employed in the dry parts of the booth. Accordingly, Linatol (a product with a high pigment-to-oil ratio) was made; it sticks on the walls of the booth but can be washed off with a hose and does not injure or damage the sludge if any happens to get into the circulating system.

With the advent of urea-formaldehyde resin in our enamels, our recovery process changed from the straight heat-mixing-water evaporation process to the full vacuum method until the water was down to about 1 per cent, followed by reduction, clarification, etc. Obviously, the heat method polymerized the urea-formaldehyde resin, which was not only a loss but also troublesome in the filtering and clarifying operations.

Chrysler Corporation has reclaimed and used (not counting undercoats) the following amounts of paint in five years; three of these years include only the Plymouth sheet metal lines (no water booth in other plants):

Lacquer	450,000 gallons
Enamel	555,000
Clear lacquer	84,530
	1,089,530

Samples of almost every batch of lacquer and synthetic enamel reclaimed have been sprayed out on panels and sent to Florida for exposure tests. Sixty-five panels of reclaimed lacquer have been sent to the rack, and in all

LATE DESIGN SPRAY BOOTH IN CHRYSLER'S PLYMOUTH PLANT

Note the distance of the fender from the water curtain, and the enormous volume of water flowing over the curtain and into the trough. If the fender was appreciably closer to the curtain, drops of water might splash on the fender causing harm to the paint system. Pipes from booth to main sludge tank are not used but rather troughs which can be opened readily and cleaned as necessary.

cases the durability has shown up slightly better than the original materials. With reclaimed enamel, one year of Florida exposure on 283 panels has been completed and 1092 panels are still under test. So far, the one year exposure panels have been equal to the average of all the colors of the original enamels. In addition, our supplier takes one sample of reclaimed enamel every week for a complete check. To date they have found no reason to complain about durability. This statement does not include the period when mineral seal oil or soluble oil was used as reclaiming medium. Unless longer baking schedules than were possible on our line were employed, line checking ensued after 6-month exposure.

Besides the lacquer and synthetic enamels used in the automotive industry, we have reclaimed undercoats (oil base), aluminum paints, white enamels used on refrigerators, varnishes, red and green enamels used on tractors, and enamels used on washing machines.

For example, the so-called refrigerator enamels present certain problems after recovery: (*a*) The tinting color is usually lost and must be replaced. (*b*) These white sludges do not occlude so much water as automotive finish sludges (refrigerator enamels 12

per cent, automotive enamels 40). (*c*) So far on all our tests, wherever non-injurious compounds (such as Linatol and Bricate) are used as booth lubricants in the wash water, the durability of the recovered material has been satisfactory. This includes all the physical properties—dry, flow, luster, humidity resistance, etc. Some hydrolysis does take place and shows up in the loss of zinc whether the zinc is used as a drier or as a pigment; but generally this loss has not been high enough to make any additions necessary.

One of the most important aids to successful recovery is the spray booth. If this were more generally realized, perhaps booths would be designed better and both user and supplier would be benefited.

All enamels and even lacquers contain a certain amount of residual solvent, depending on the distance of the spray gun from the water curtain, movement of air through the booth, temperature of air, etc. Typical examples are: Plymouth enamel sludges, 18 per cent; clear lacquer (at the Dodge plant), 7 per cent. Generally speaking, the higher percentage of retained solvent, the more tendency to wet or stick to walls and pipes, etc. The pH of the system also has a bearing on the ease of handling or stickiness of the sludge. With our type of material the wash water, if left alone, will reach and hold a pH of 5. We add regularly enough ammonium hydroxide (26° Bé.) to keep the pH average at 8. At this point the sludge has the best consistency for handling. In our system this amounts to $1\frac{1}{3}$ pounds of ammonium hydroxide three times daily for a 3000-gallon system. With refrigerator enamels the acidity at the start is so low that this addition has been unnecessary.

The changes that actually occur when paint is recovered and how these changes affect the product are the questions of interest in this discussion. The results are based chiefly on standard paint practice tests (physical properties and exposure records):

The acid value always goes down; with our enamels, on a solids basis, the decrease is from about 35 originally to about 20 on reclaim. In the case of refrigerator enamels the acid number is so low originally that not much change occurs—5 to approximately 4.5 on a solids basis. Viscosity likewise decreases.

The flow properties are definitely better, probably because of lower acid number and lower viscosity.

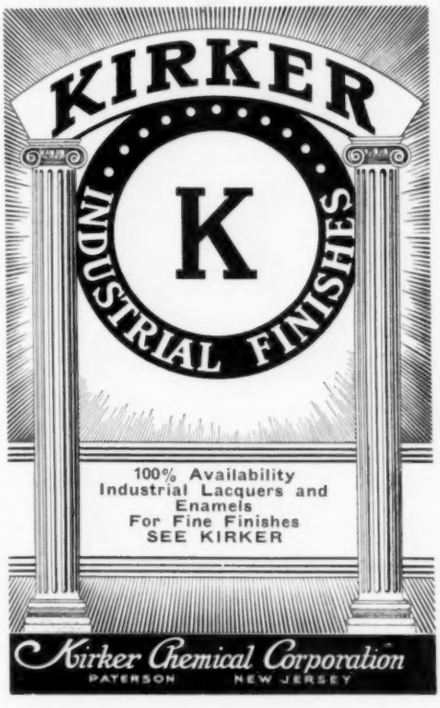
An excess of uncombined fatty acids is leached out without the resin-agglomerate basis being changed.

Some hydrolysis takes place, with a slight loss of zinc as drier and as pigment. For enamels in which 6 per cent of the pigment is zinc, we go down to approximately 4 per cent. The drier loss is negligible, and now that urea-formaldehyde resins are employed we cannot measure the difference in drying time.

Because of the nature of the water-type spray booths, we find ourselves with a type of washing or leaching process which makes for improvements in finishes. This is due to the fact that the surplus of water spray washes out any slight excess of water-soluble oils, such as free fatty acids, from the fine paint particles. Although suspected often, never yet has the solid agglomerate split up into strange new components. Apparently an agglomerate particle which is put together with heat and/or pressure chemically or forcefully is too strongly knit to break down under a mere deluge of water, which is essentially neutral.

In conclusion we believe from our experience that all the present types of coating materials can be successfully reclaimed and used to advantage. In our case at least, any new paint or enamel which does not lend itself rather readily to the art of reclaiming would have to go a long way up the scale in more desirable qualities to cause us to give up reclaiming.

Hercules Powder Co., Wilmington, Del., has announced the purchase of the synthetic resin business of *John D. Lewis, Inc.*, Providence, R. I., producer of synthetic resins. Hercules is the largest U. S. producer of rosin and is also a manufacturer of synthetic resins. The transaction was effected July 1, 1941, and Hercules acquired the land, buildings, equipment and processes of the Lewis synthetic resin plant at Mansfield, Mass., and the entire plant at Brunswick, Ga. John D. Lewis, Inc., will continue in the production of textile and heavy chemicals at Mansfield, and its sales and manufacturing facilities for resins under the direction of *W. M. Billing* who will join the Synthetics Department of Hercules.



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Notes On Lacquering

By FRANK V. FAULHABER

Brooklyn, N. Y.

Applying Glazing

When finishing castings and it is desired to produce a uniformly even surface showing no irregularities, pits, etc., the usual practice is to glaze over the surface with putty or glazing material. Too heavy a layer should not be applied at one time, since it requiries too long to dry properly and the putty or glaze might crack open. Some plants allow as much as 12 hours for each application of oil base glazing mixture and 8 hours for lacquer base materials, although the work can be considerably expedited by force drying.

Ordinarily no surfacer coat of any kind is applied in finishing stamped metal articles bearing no file marks, unless the aim is to give depth to the finish. In such case a light coat of surfacer should be sprayed on and sanded smooth with fine water-proof sand-paper. After the working surface is reasonably well smoothed down with the glazing material, the surfacer coats can be applied. In some shops the procedure is to lay on a coat or two of surfacer prior to glazing. These surfacer coats should be applied lightly. An over-heavy coat of surfacer tends to chip the finish off easily once the product is in use. Some foremen allow 8 hours drying time for oil base surfacer coats and 4 to 6 hours for lacquer base primers, although here again the time element can be appreciably hastened by oven drying. Preferably each surfacer coat should be sanded smooth and dried thoroughly before receiving another coat.

The sanding of surfacer coats should be done lightly, using plenty of water. In finishing large units, mechanical sanders are particularly appropriate and they operate either by air or electricity.

In some instances, oil base materials are never sanded, simply being given a final coat of clear lacquer that produces a natural gloss. In some cases this final coat is highly polished. The character of products manufactured usually governs individual finishing procedures.

Finishing Coats

When final surfacer coats are completely clean and dry, the finishing coats are next in order. The most effective method is to allow adequate drying time for each coat, using fine sand-paper for a light sanding and washing thoroughly each time. As preferred, oil base materials may be sprayed on lacquer base materials, or lacquer base finishes may be applied over oil base coats. Some finishing foremen discountenance the method of applying one coat such as oil primer, then a coat or two of lacquer surfacer, that is then finished off with finishing applications of oil base enamel.

In all cases different types of material and products to be finished in lacquer call for specific qualifications of the finish itself. In explanation, it should be flexible, glossy yet not brittle, have durable features, withstand buffing and reasonable heating, make for inexpensive, facile finishing, and assure an attractive, dependable finish.

A lacquer finish may look well as the product is completed in the factory, but the important question is: How will that finish stand up under use? For that reason the nature of the product to be finished, as well as the lacquers themselves, must be taken into consideration. Many plants maintain special experimental departments that regularly conduct tests of various finishes and analyze their products. The findings enable the management to proceed with greater confidence and a certainty that the products made will stand up under all phases.

Ageing Tests

Some plants give their products ageing tests. By means of a machine, over any desired period of time, sample finished items can undergo conditions simulating outdoor exposure. This machine is known as a weatherometer especially intended for the purpose. Panels applied with specific lacquers and other experimental finishes can be placed at various points, wherever the management chooses, to determine probable values and practicality of different finishing materials. Such tests fortify a plant against using on too large a scale new finishes that later may prove unsuitable.

Comparatively inexpensive lacquers may prove decidedly expensive and a liability when lacking desirable characteristics such as beauty or sales appeal, speedy uniform processing, covering powers. Even though a given lacquer finish stands out sturdily, it may fail to lend charm of the proper degree to the product. Too much work and time may be entailed in laying down a good finish. Gallonwise, all lacquers do not cover an identical amount of surface. Much might be written in detail regarding these vital points, but it will suffice to state that the purchaser of lacquers must think beyond the quoted price of a given lacquer when comparisons are about to be made.

Special Lacquers

Within recent years, lacquer manufacturers have made great strides with their products, developing special lacquers for various purposes to meet almost any finishing plant's requirements. It is a wise procedure when the plant management discusses the lacquer problems with lacquer manufacturers' representatives. They undertake to give demonstrations of their products and supply pertinent, instructive literature that help the plant in its problems.

It is well to bear in mind that even the products of high lustre will frequently become smutty and greasy by reason of the succeeding operations and handling after lacquering. It is but further painstaking precaution, that pays the plant in the long run, when all grease and finger-marks are

BAN ON COATING METALS FORCES QUICK SUBSTITUTE

Important information for executives who must find a suitable replacement -- quickly for galvanizing or other metallic coatings.

WITH today's shortage of protective coating metals: zinc, tin, cadmium, and nickel, plant executives are facing immediate abandonment or at least careful conservation of them for only the most vital uses. Baked organic finishes hold the most reliable promise of permanent availability, and these can become an acceptable substitute only when the baking process is conducted under proper conditions. In this connection, Morrison experience dates back many years and into the hundreds of successful paint and japan drying oven installations.

Briefly, here is what Morrison ovens offer you in the present emergency: 1) Moderate price based on offering standard units. 2) Prompt delivery due to this standardization plus the fact that materials are ready for immediate construction. 3) Foresight will be used in making oven recommendations so that they will have future productive uses when coating metals are again available. 4) Advice on material handling will be gladly given, based on wide experience in this problem. 5) Morrison ovens are outstanding for their uniform heat, precision control of both temperature and atmosphere, and correct ventilation which are all necessities in good baking results. 6) These ovens have high fuel economy with either oil or gas and occupy small space in proportion to their output.

We are prepared to give you the prompt service and intelligent cooperation the present situation requires, and urge that you get in touch with us immediately.

MORRISON ENGINEERED

MORRISON ENGINEERING CORP.

5005 EUCLID AVENUE • CLEVELAND • OHIO

removed by competent, conscientious polishing, so that the finished goods will be immaculately clean before starting to ship them.

In the interest of a satisfying shipment, special attention should be accorded this phase of the work. The value of any product, however efficiently lacquered, is further enhanced by appropriate inspection, polishing, careful wrapping and packing. Even the most carefully made product will not be bright, shiny and attractive if it is not given pre-shipping cleaning and polishing. It is indeed surprising how some plants, otherwise exacting and discriminate in their finishing operations, neglect this so vital feature.

For illustration, in the manufacture of etched silver-finished dials, gauges, name-plates, and similar items, it is meet that following the completely finished operations, the succeeding operators handling the work exercise care in handling and manipulation. A careless press operator may slight its importance, yet he should be cautioned against scratching the lacquered work.

Workmanship Nullified

A sloppily-oiled machine will perform sloppy work. Ignorance or indifference, much of the otherwise exemplary execution of workmanship oftentimes thus is nullified by rough-handling press workers. Therefore it is expedient to accord a little thought to this angle of manufacturing in the interest of better lacquered products.

Naturally the more care and regard that is exercised by each operator, during the various processes, the less added work attaches preparatory to examining and packing. Handled products, of course, will always receive finger-marks, more or less; yet it is possible to so manipulate them that there will be few objectionable traces on the finished surfaces. The importance of this can not be unduly stressed particularly when we consider high-grade lustered finished work where it is necessary that additional polishing be avoided. A careless rubbing, however well-meant, of high-grade silver clock dials, for instance, may deplorably negate all the preceding good work.

It should not be overlooked that the manufacturer is achieving a better reputation for well finished lacquered products, when high grade lustered articles are received in attractive, clean, immaculate condition. This extra precise precaution ensures a more commendable and worthy product, conducing to make it stand out, as it deserves.

The manufacturer of superior lacquered products who strives for a reputation will insist that only the best be shipped. This should rule out, of course, all questionable, inferior, mediocre work. Those who assemble and assort the various parts should throw aside all the defective ones, some of which, perhaps, may be touched up, passably if adeptly, then sometimes re-lacquered and then included in the shipment. Some manufacturers, however, do not desire to send out what they term touched up or botched pieces, and this policy is to be commended.

Encouraging Botch-work

Assuredly in that plant where many re-touched and worked-over articles are shipped, employees are sometimes inclined to excuse careless work. Thus, hasty, indifferent employees are liable to turn out more poor work than usual. This is an angle that cannot be given too much reflection, for some factories.

It is well to remove flaws in work, but it is doubly important to remove the causes that invite these flaws. Notably on colored etched lacquered work, where additional paints must be sprayed on, separately, diligent care is essential. Goods of this type frequently show a high percentage of poor or damaged pieces. This work is often re-touched, yet it is never as good as that not requiring these supplementary, palliative operations.

Employees examining and counting such pieces as name-plates, dials, and the like, should lightly polish the larger and brighter silver-finished items, especially when high-grade work is specified. This is not usually necessary on some pieces, but the added praise of the customer who is satisfied with the workmanship is appreciated. All that is necessary is a clean common cloth that will free the particles of oil, finger-marks and dust particles.

One large plant specializing in highly lacquered and bright lustered name-plate work makes it rigid procedure, even in the case of small orders of 100 plates, to wrap the larger silver-plated dials ten in a small pack, in such a manner that no two dials contact each other. A dial is placed on a piece of tissue paper of the proper length, the tissue is folded over to cover this plate; a second dial is placed, and this method followed until the pack of ten is completed.

Wrapping Delicate Work

The tissue paper being smooth and soft, the tendency to scratch or mar the fine lacquered work, up to the point of delivery of the shipment, is held down to the lowest possible minimum. In the case of smaller etched plates, such as the usual run of black finishes, the plates can be packed in tens or twenty-five packs, within tissue, separately, as in the foregoing described, only when special conditions warrant. Packed in the initial tissued wrappings, this work then should be enclosed in tough Kraft paper, for instance, and, in the case of large shipments, these packages should be so placed in the shipping containers, preferably wooden boxes securely metal strapped, so that the packages will set firm and not loosen at any time during shipping. Smaller orders suggest similar care in packing.

The smaller packages that perhaps may be sent by Parcel Post should be packed in tough, strong manila, securely bound by strong cord. Often what appears to be a well-bound package reaches the consignee in a very loose, unsatisfactory condition. The plant should make it a practice to see that every container or package of highly lacquered work, such as name-plate products, be substantial and strong enough to withstand rough handling. Too many customers have complained of receipt of inferior, scratched lacquered articles that were unequivocally high-grade and first class at every phase of finishing operations up to the final point of packing and shipping. Therefore the manufacturer of this character of work cannot be over conscientious and cautious in paying due heed to this angle of operations.

Patent Digest

Organic Coating

U. S. Pat. 2,245,745 G. L. Ball, assignor to Ball Chemical Co., June 17, 1941. A method of forming a thin aluminum-pigmented alkali-resistant baked coating on metal which comprises the steps of pigmenting a film-forming heat-convertible vehicle containing a drying oil and an oil-soluble thermoplastic resin of low acid number

capable of sustaining relatively high temperatures with aluminum dust in such impalpably fine division and in such small content not substantially exceeding one part by weight of aluminum dust to 20 parts by weight of the film-forming non evaporative content of the vehicle that in a thin film of about 0.25 to 0.50 mil in thickness the aluminum pigment lies protectively covered by the vehicle, spreading a thin coating of this pigmented vehicle on the base metal, and heat converting the said film by subjecting to a treating temperature of about 700° F. for ¼ minute to produce on the base metal an adherent coating having high alkali resistance by virtue of the encapsulation of the aluminum pigment by the heat converted vehicle.

Organic Coating

U. S. Pat. 2,249,498 W. Schulze (Germany), assignor to General Electric Co., July 15, 1941. The method of preparing a liquid coating composition which consists of the steps of incorporating a small amount of an organic peroxide into a polymerized acrylic compound, heating the resulting product and dissolving the heated product in a volatile solvent therefor to form a liquid mass.

Organic Coating

U. S. Pat. 2,248,961 H. C. Comstock, July 15, 1941. A composition comprising medium oil varnish approximately 17.6% by weight, beeswax having a melting point 140-150° C. approximately 0.3% by weight, boiled linseed oil approximately 9.6% by weight, balance mineral spirits having an initial boiling point 300-310° F. and an end point 390-400° F. to make 100% by weight, said composition being characterized by its property of drying rapidly when applied to a clean metal surface, leaving a single transparent flexible primer and surfacer coating tenaciously bonded to said metal surfaces.

Spraying Process and Apparatus

U. S. Pat. 2,247,000 M. Popoff (Germany), June 24, 1941. A spray gun of novel design for coating surfaces with liquid particularly paints and lacquers.

Coating Composition

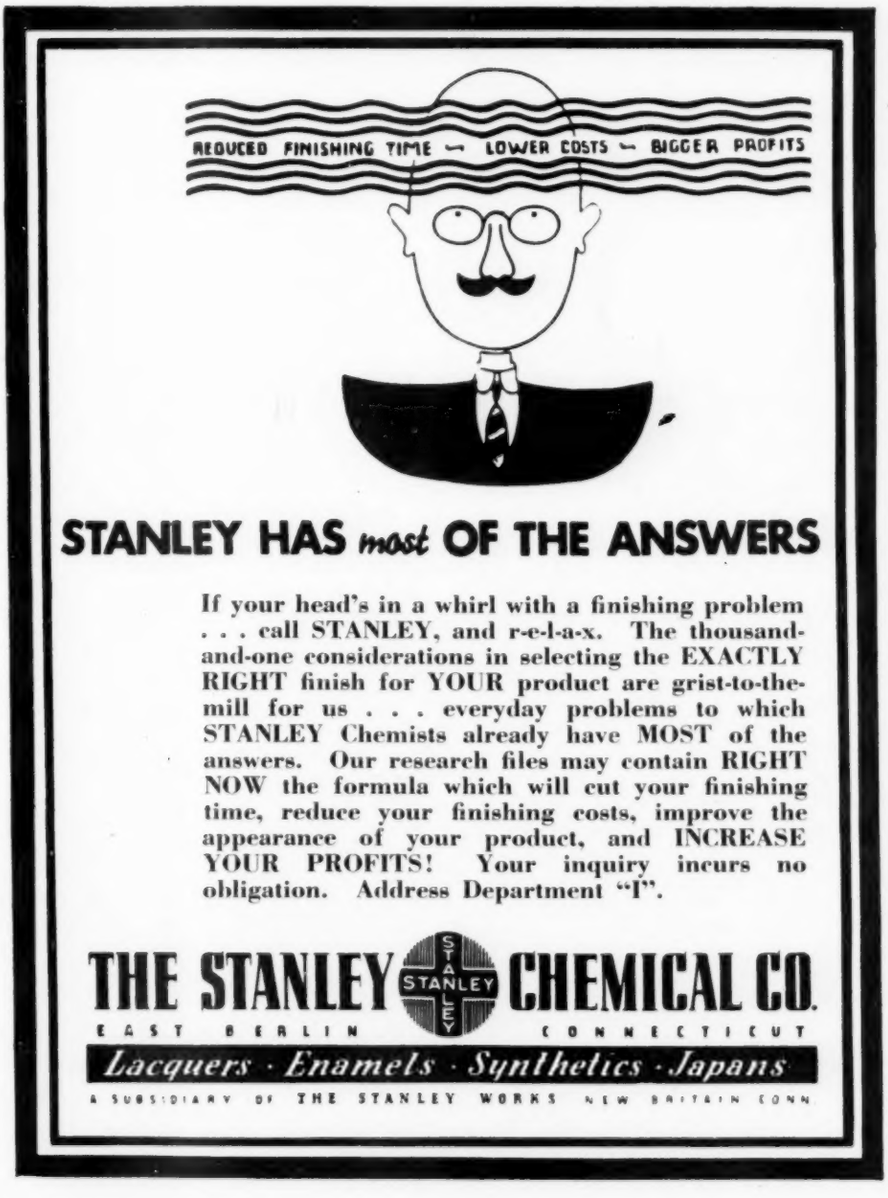
U. S. Pat. 2,246,095 S. Graves, assignor to E. I. duPont de Nemours & Co., June 17, 1941. An enamel yielding substantially non-yellowed films upon baking which comprises pigment consisting preponderately of titanium pigment, polyhydric alcohol-polybasic acid resin containing in substantial amount the acid radicals of fatty acid having an iodine number below 100, and urea-formaldehyde-monohydric alcohol resin containing said alcohol in combined form in amount from about ½ to about one molecule of alcohol for each molecule of urea and yielding upon treatment with zinc chloride and acetic anhydride the acetate of said alcohol, said pigment being present in amount of from 75% to 125% of the weight of the vehicle contained in said enamel.

Organic Coating

U. S. Pat 2,245,708 C. W. Patton, assignor to Carbide and Carbon Chemicals Corp., June 17, 1941. A process of coating articles which comprises applying to their surface a homogeneous fluid dispersion of a vinyl resin in an essentially volatile organic liquid composition maintained at an elevated temperature, said liquid composition being composed of a mixture of an active solvent for the vinyl resin and an organic liquid of the group of volatile aromatic hydrocarbons, ethylene glycol monobenzyl and monobutyl ethers, diethylene glycol monobutyl ether and diacetone alcohol, which mixture is incapable of forming homogeneous fluid dispersions with said vinyl resin at ordinary temperatures but capable of forming such dispersions at said elevated temperature, and thereafter removing the volatile portion of said organic liquid composition from the applied dispersion and depositing on said surface an essentially homogeneous, strong and flexible resinous film of said vinyl resin, the vinyl resin being substantially identical with the one resulting from the conjoint polymerization of a vinyl halide with a vinyl ester of an aliphatic acid containing from about 70% to about 95% by weight of the vinyl halide.

Vitreous Enamel

U. S. Pat. No. 2,244,360 J. C. Gallup, assignor to Radio Corporation of America, June 3, 1941. A vitreous heat resisting enamel which adheres firmly to nickel and consists of 55% - 65% silica, 4% - 15% calcium oxide, 5% - 10% boric anhydride and 20% - 25% alkali composed of sodium oxide and potassium oxide, said enamel having a coefficient of thermal expansion substantially the same as that of nickel from room temperature to about 600°C., a softening point of approximately 600°C., a melting range of about 900° - 950°C. and an electrical resistivity of about 1 x 10^{13} ohm centimeters.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Solvents In Industry

Benzene

(benzol)

Physical Properties

Benzene (not to be confused with benzine which is a petroleum fraction composed mainly of the paraffin hydrocarbons, octane and nonane) is the first and simplest member of the aromatic hydrocarbons possessing a characteristic aromatic odor which has come to be associated with rubber cements through its use in such materials. Its chemical formula is C_6H_6 and it has a molecular weight of 78.11. It is listed as having a specific gravity of 0.874 at 20°/20°C. (approximately 7.31 pounds per gallon or about seven-eighths as heavy as water). Benzene melts at 5.5°C. and boils at 79.6°C. at 760 mm. mercury pressure. The vapor pressure of benzene varies between 75 mm. and 118 mm. of mercury at 20°C. and 30°C. respectively. Referred to normal butyl alcohol as having an evaporation rate of 100, benzene has an evaporation rate of 904, that is, it evaporates faster than normal butyl alcohol in the ratio of 904 to 100. It is slightly slower in evaporation rate than acetone and slightly faster than ethyl acetate.

With most volatile organic solvents benzene is miscible in all proportions and is an excellent solvent for many resins, waxes, oils, fats, rubber, etc. It is soluble in water (at 20°C.) to the extent of 0.06 per cent by weight and water is soluble in it (also at 20°C.) to the extent of 0.06 percent by weight. Benzene does, however, form a constant boiling (azeotropic) mixture with water which contains 91.4 per cent by weight of benzene and 8.6 per cent by weight of water and which boils at 69.25°C.

The closed cup flash point of benzene is listed as -11.1°C., which, incidentally, is unusual in that it is lower than the melting point of the substance. The upper and lower explosive limits in air are 1.4 per cent and 8 per cent by volume respectively. The autoignition temperature is 575°C.

Chemical Properties

Benzene and its derivatives possess chemical properties which are so typical of this class of compound that they are often referred to as the aromatic properties. These properties, of special interest to chemists, include (1) resistance to oxidation, (2) acidic properties of hydroxyl derivatives, (3) failure to react with chemicals which usually react with other unsaturated compounds, and (4) ease of substitution of the hydrogen atoms by other atoms or groups of atoms, including such substitution reactions as halogenation, nitration, sulphonation, etc.

Physiological Properties

Like most organic solvents, benzene removes the natural oils from the skin when in contact with it and may produce dryness, cracking of the skin and irritation. Because of its extremely toxic action, it is not recommended for use in finishing materials, etc. except where ventilation complies with health regulations.

Manufacture

Benzene was discovered by Michael Faraday (famed for his researches in the field of electricity and magnetism) in 1825. He obtained it by the fractional distillation of an oil which was the by-product of the manufacture of illuminating gas from whale oil. Twenty years later benzene was isolated from coal tar by A. W. Hofmann. Today large volumes of benzene and other materials are derived from the coal tar which results from the destructive distillation of coal in the manufacture of coke.

Coal tar is refined by distillation and by chemical treatment. A typical coal tar will produce the following per 1000 pound: Benzene, 16 lbs.; toluene, 2.5 lbs.; xylenes, 0.3 lb.; phenol and cresols, 20 lbs.; naphthalene, 40 - 60 lbs.; anthracene, 5 - 20 lbs.; pitch, 500 - 600 lbs.

Benzene may also be prepared by a number of chemical reactions. For example, acetylene at high temperatures (500°C.) polymerizes to benzene:

$$\underset{\text{acetylene}}{3C_2H_2} \rightarrow \underset{\text{benzene}}{C_6H_6}$$

Phenol (carbolic acid) heated with metallic zinc gives benzene plus zinc oxide:

$$\underset{\text{phenol}}{C_6H_5OH} + \underset{\text{zinc}}{Zn} \rightarrow \underset{\text{benzene}}{C_6H_6} + \underset{\text{zinc oxide}}{ZnO}$$

Benzene may be prepared from sodium benzoate and sodium hydroxide. Sodium carbonate is the other reaction product.

$$\underset{\text{sodium benzoate}}{C_6H_5COONa} + \underset{\text{sodium hydroxide}}{NaOH} \rightarrow \underset{\text{benzene}}{C_6H_6} + \underset{\text{sodium carbonate}}{Na_2CO_3}$$

Uses

When the variety of volatile organic solvents was not as wide as it is today, benzene was an important constituent of finishing materials, cements, etc. However, because of its toxic properties, its use is centering more and more in the field of synthetic chemistry where it is an important material as a reagent and as a starting point or raw material for such substances as aniline, nitrobenzol, phenol, picric acid and many other valuable and useful organic compounds.

Specifications

Benzene appears on the market in a number of grades. The following are data on one grade of commercially available benzene.

Color	not darker than solution of 0.003 gram of potassium bichromate in one liter of water, compared in [illegible] cc. Nessler tubes.
Distillation	100% between 79.2°C. and 120°C., at least 90% distilling at 100°C.
Acidity	No evidence of acidity.
Specific Gravity	0.875 to 0.886 at 15.5°/15.5°C.
Sulphur Compounds	Free from H_2SO_4 and SO_2
Average Weight	7.31 lbs. per gallon at 15.5°C.

Dilution Ratio

Question. In connection with lacquer solvents and diluents, what is the significance of the dilution ratio? Also, will you please give the details for conducting the test by means of which dilution ratio is determined.

Answer. As is generally known, some solvents will dissolve nitrocellulose. Others will not. However, solutions of nitrocellulose and some solvents will tolerate the addition of certain amounts of non-solvents (diluents) without precipitating the nitrocellulose. The dilution ratio test gives a measure of the tolerance of a solution of nitrocellulose for diluents, that is, it indicates the amount of diluent which can be added to a nitrocellulose solution without precipitation or separation of the nitrocellulose.

The general procedure for determining dilution ratios is as follows. An accurately weighed amount of dry one-half second nitrocellulose is placed in an erlenmeyer flask and an accurately measured volume of solvent added. The flask is then shaken until solution is complete. The diluent is then added in amounts of one cubic centimeter, with vigorous shaking, until the nitrocellulose just begins to separate. The weight of nitrocellulose and the volume of solvent used should be such that the concentration of nitrocellulose at the end point is approximately eight grams per 100 cubic centimeters of the final mixture. The dilution ratio is expressed as the ratio of the volume of solvent used to dissolve the nitrocellulose to the volume of diluent required to just produce precipitation of the nitrocellulose.

The method requires some practice, but a few determinations are usually sufficient to acquaint the operator with the amounts of dry nitrocellulose and solvent required to give a final nitrocellulose concentration of eight grams per 100 cubic centimeters of final solution.

S-310

CLEAR RUST INHIBITIVE

S-310 is a clear, pale liquid which can be reduced 150-200%. This solution can be applied to bright metal surfaces by dip or spray and gives a remarkably hard, tough and adhesive film of pronounced resistance to rust or tarnish.

S-310 is now used by many manufacturers of hand tools, e.g., hatchets, shears, pliers, axes, auto wrenches, etc.; for hardware of the better grade; for the bright metal surfaces of machine tools.

S-310 is indicated wherever a thin, hard, non-greasy film that resists rust in transit and storage is desired.

We welcome inquiries as to its applicability to your specific problem.

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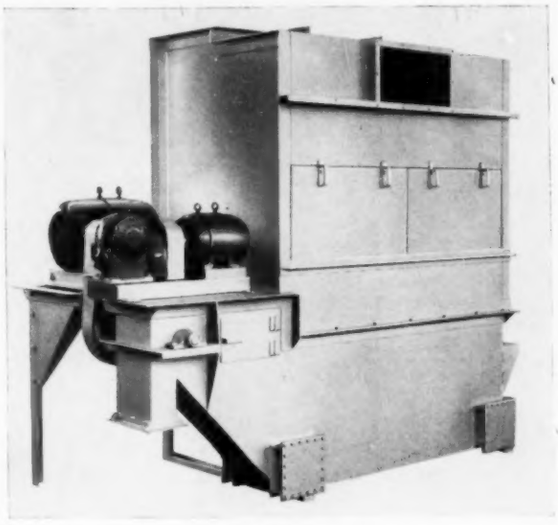

Another Dust Problem *Solved!*

Space was limited the high efficiency of the Hydro-Whirl, however, was demanded. "Industrial" engineers met the situation by designing a unit in a more compact form. Not a single feature that has made Hydro-Whirl such an outstanding dust collector was sacrificed. Both height and length were reduced to conform to limitations presented in the plant. One installation of five units of this type has just been completed.

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If you have a dust problem, you should ask one of our engineers to discuss ways and means of solving it. We have licked many tough ones.

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LATEST COMMERCIAL DEVELOPMENTS IN ORGANIC FINISHING

Slow Speed Air Powered Mixer

Eastern Engineering Company, 45 Fox St., New Haven, Conn., have announced the development of a slow speed air powered mixer, called "Eastern A-2 Air Powered Mixer."

This mixer is stated to be explosion-proof and has a special high torque slow speed air motor to make it suitable for heavy mixing and slow powerful fluid handling. It is variable in speed and can thus be used in applications where otherwise two or more mixers of various sizes would be required. It is completely enclosed, thus making it suitable for use in places where splashing or fumes may be harmful to the motor. It can be used only where compressed air is available.

Slow speed air-powered mixer

The air motor is rated at 1½ H.P. with a maximum speed of 400 R.P.M. on 40 lb. pressure. The speed can be varied by changing the air pressure. An adjustable clamp is provided for convenient attachment to the edge of the container. A stainless steel shaft is coupled to the motor through a nickel plated tube type coupling. A 12" diameter nickel plated bronze propeller is fastened to the end of the propeller shaft.

The assembly can be furnished with dual propellers or with Monel metal or stainless steel construction.

Paint for Plaster and Cement

An oil paint called "Bondlite" has been developed in the Wilbur and Williams Company's laboratories which is stated to be safe to paint over new damp plaster or brick, concrete, cement or stucco outside though it is only a day old.

Formerly, it was necessary to wait several weeks for the plaster to dry before an oil paint would adhere satisfactorily to the surface, due to the fact that the lime in the plaster would affect the oil paint, and also that the dampness would be sealed into the surface, causing deterioration of the plaster.

The manufacturers of this paint claim that their material, even though an oil paint, is not affected by lime or alkali, and, at the same time, they have succeeded in producing a breathing paint which does not seal in the moisture, but allows it to dry out naturally as it should.

This new paint, as reported by the manufacturers, has all the qualities of a high-grade paint, is very durable, and provides a tremendous saving in time, which in turn means a saving in labor costs. The "Bondlite Interior" is said to be fool-proof, and is being used today in office buildings, new homes and new buildings where they can plaster one day, and paint the next day. In some cases, they have even painted that night.

This new oil paint can be obtained in both an interior mixture and an exterior mixture. According to the company, other characteristics of the material are that it is inexpensive, safely paints over calcimine or whitewash, is non-yellowing even in white, dries in about an hour, and is washable as a good grade of oil paint.

The Wilbur & Williams Co., Park Square Bldg., Boston, Mass., will be glad to furnish more pertinent information on painting problems of this nature at any time.

Light Duty Feed Material Tank

Paasche Airbrush Co., 1909 Diversey Parkway, Chicago, Ill., have a new low-priced light duty special feed material tank for organic finishing, which has a full size 6" opening for easy cleaning and a "clamp-tight" cover which is claimed can be taken off and placed back on the tank in less than 15 seconds.

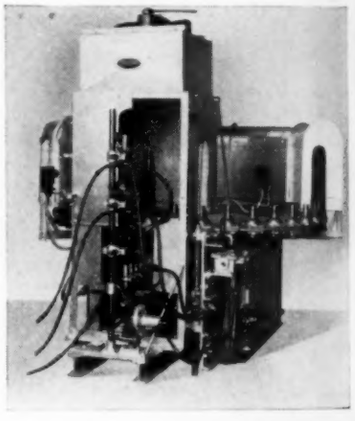
Other features described are an accurate pressure regulator with a large easy-to-reach gauge, a large fluid tube with strainer and a safety valve. The tank holds up to 50 lb. pressure and is supplied at the present time in only two-gallon capacity. If the tank is wanted without regulator and gauge for use on low pressure lines up to 50 lb. it can be thus supplied.

Light duty feed material tank

Electric-Eye Operated Sprayer

The Eclipse Air Brush Company, 400 Park Ave., Newark, N. J. is building automatic spray machines with electric eye control to coat the inside and outside of projectiles in one operation.

The shells are placed on the indexed turntable manually, carried around to a position in front of automatic spray guns that coat the outside, while an extension nozzle on another gun comes up to spray the inside.



Electric-eye operated sprayer

The action of the guns is controlled by an electric eye device so that there is no spray unless a shell is in the holder.

After being sprayed, the shells enter a steam jacketed oven that is built over the back of the table. When they emerge from the oven, the projectiles are removed by the operator.

This machine will handle 75 mm. armor piercing shells at a rate of 500 an hour.

Corrosion Prevention of Tin

U. S. Pat. 2,245,561 V. Nelson and A. C. Herro, assignors to Carnation Co., June 17, 1941. A can or container of tin plate material for containing food products which is provided with a protective coating comprising a film of sulfide formed by subjection to a strong sulfidizing reagent.

Example: Expose to equal parts of hydrogen sulfide and air at 350-400° F. for 3 minutes.

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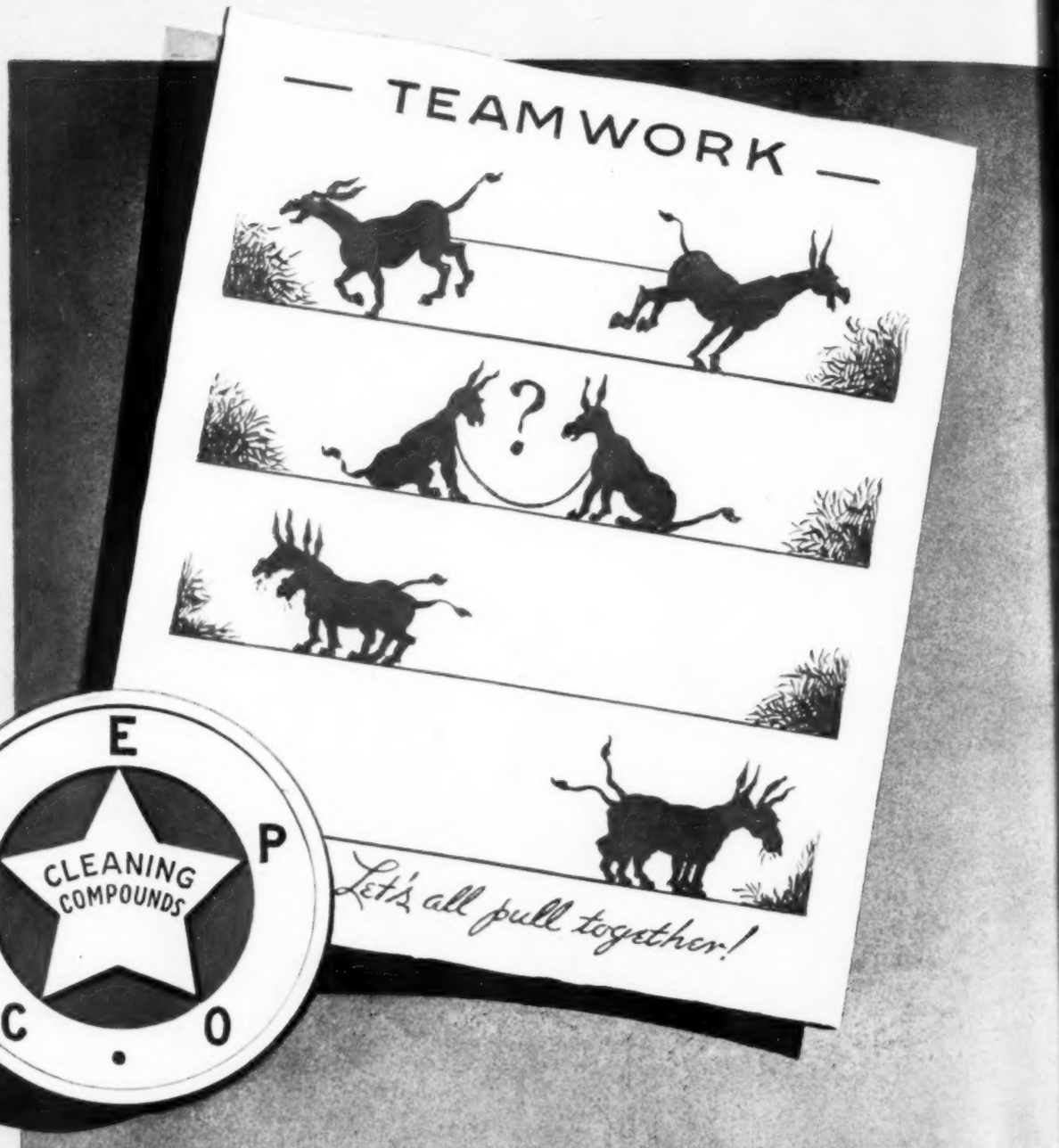

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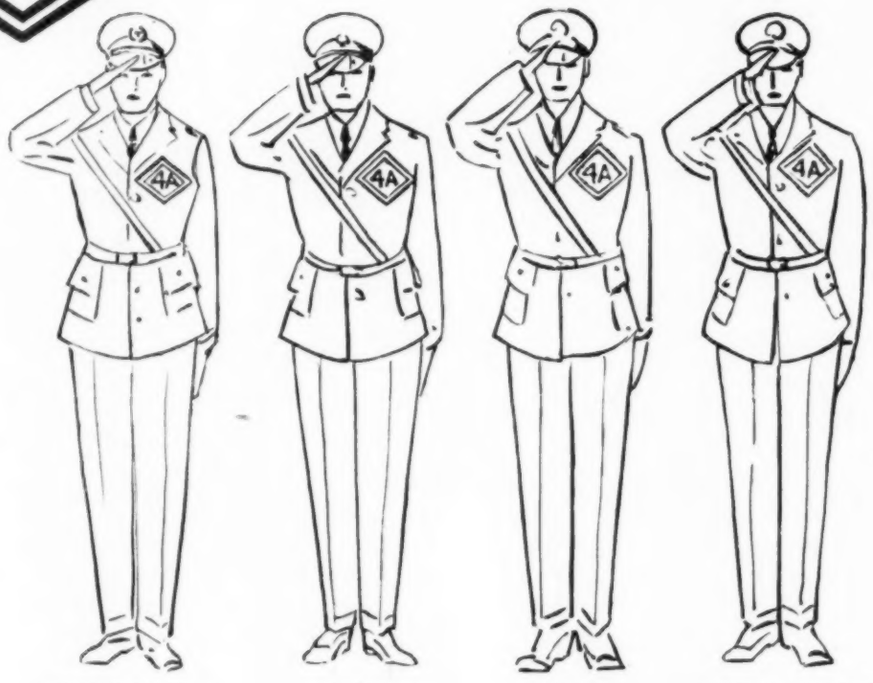

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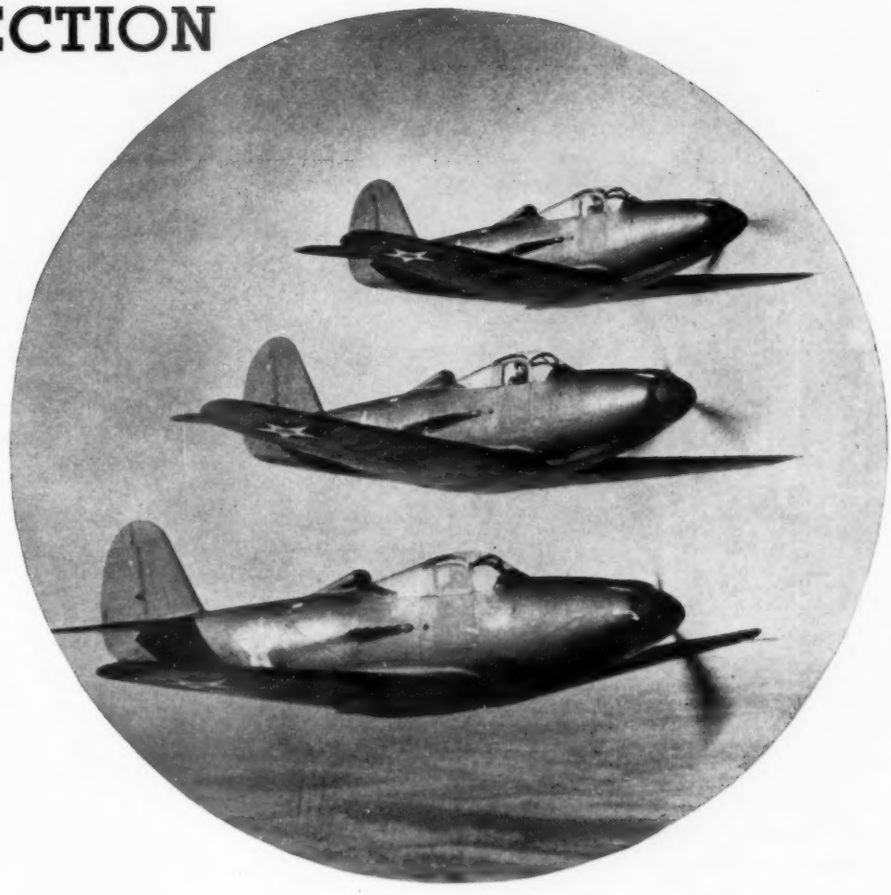
DEFENSE SECTION



The Impact of Defense

THE defense effort is beginning to jolt us. To fight for democracy and against Hitlerism, we have turned our factories into arsenals—conscious that we are about to deprive ourselves of some of our most-prized comforts. We are diverting our iron and copper and aluminum to the making of guns and tanks and planes and ships to be used in the defense of democracy.

During the past summer our employment and production, stimulated by defense spending, were at peacetime highs, exceeding even the peak of 1929's boom.

Already the funds allocated for defense purposes have mounted to more than $60,000,000,000. This is more than all the wages and salaries paid in the United States during 1929, when wage and salary payments broke all records. It is more than the entire national income in any of the five depression years.

The impact of this tremendous program will mean more work, more pay, for Americans.

Gradually, however, the impacts of defense production and spending, and the effects of conservation of materials imperatively needed for national defense, are beginning to hit some of us. In the few months before Christmas, everyone will feel it more and more. Santa Claus will be on hand, but he'll have to deal out Defense Bonds instead of gadgets.

A new tax law, adding more than three billion dollars annually to the government's revenue, will take a much larger proportion of everyone's earnings, starting back to last January.

The government, through its control over credit, has tightened up restrictions on installment-plan buying, making it harder to buy luxuries and semi-luxuries, and easier to invest money in government bonds—part of a conscious effort to reduce excessive spending and its inflationary effects on prices. You now need one-third cash as down payment to buy a car.

Use of all silk for stocking and other civilian uses was cut off when the freezing of Japanese raw silk imports made it necessary to save our entire supply for powder-bags and parachutes. Some panicky women stormed the stores, but most of us are helping by depending upon American mills to provide nylon and rayon stockings

when the need comes. Cotton stockings may become fashionable.

A shortage in transportation facilities, following transfer of tankers to Britain, resulted in an Atlantic Coast curfew in filling-stations and later in a rationing of gasoline supplies by wholesale distributors. Atlantic seaboard filling-stations close at 7 p.m., and thousands of night-shift workers in them are either looking for defense jobs, or working daytime.

The automobile factories, after a year which established an all-time record production, have been told they must reduce their passenger-car production by 50 per cent. Moreover, they cannot be assured of the steel and other raw materials even for that. And although the first few 1942 models off the assembly line this month and next will have the usual chromium trim and gadgets, when these supplies are used up there won't be any more.

Also looking for defense jobs are the salesmen who have made their living from passenger cars, electric appliances, refrigerators, washing-machines, and other non-defense machines which are comfortable and useful but not now as essential as planes and guns and tanks and ships.

The factories which have been producing this rich stream of comforts are looking for defense contracts.

The men and women who have worked in the factories are preparing for defense jobs, too. Some of the men are in the armed services; some

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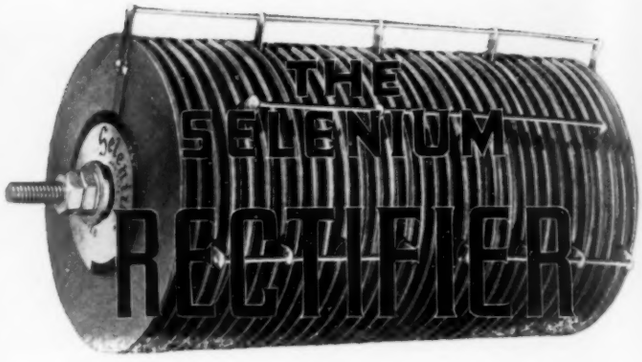

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are already in training for specific defense work in their localities; nearly all of them are facing a drastically-changed scheme of things.

All over the country, these and other changes are happening, or are about to happen, to all of us in varying degrees.

In some communities the impact will be more severe than in others. In some localities where there are defense contracts, the displacement of workers will be minor. In others, unless defense contracts are obtained quickly, the industrial workers in non-defense plants and the tradesmen and storekeepers who depend upon them, will suffer. The "one-industry" communities, particularly those which produce civilian goods using steel, copper, aluminum, and iron as raw materials, are especially alarmed.

There have been estimates that as many as 2,000,000 industrial workers may be affected in one-defense industries whose materials are needed for the mounting national defense program.

On the other hand, the U. S. Labor Department in mid-August reported that the national defense appropriations and contracts authorized to that time would require the use of 19,000,000 *man-years* of labor—and at that time, only about 4,000,000 men and women were directly employed in privately owned and government defense plants.

Conservative estimates are that 2,000,000 to 3,000,000 more workers must be added to the working force of the defense plants within a year.

The problem faced by government, industry and labor is how the non-defense worker may be re-trained and re-directed into the defense effort, to prevent us from having a community stricken with unemployment next to a community where a defense plant is seeking more skilled and semi-skilled workers.

The government has acted quickly through the Office of Production Management to meet these situations as they have arisen, in aluminum goods, silk-weaving, automobile production, and other "priority unemployment" situations.

The Material Situation

Introduction

THIS article will not attempt to cover the workings of the defense effort such as methods of obtaining subcontracts, priority forms, allocation of priority numbers, etc., but will concern itself with the status of many metals, chemicals and supplies used in the plating industry.

Due to the rapid state of flux of the materials condition of the country, the picture on any chemical mentioned may change overnight. Many materials formerly plentiful and not required directly for defense have become short due to the fact that they are being used as substitutes for other materials that are short. Thus the condition of xylol has been greatly influenced by the shortage of toluol inasmuch as toluol is being used in great quantity in defense materials.

The interrelation of the chemical industry has resulted in the shortage of many chemicals because of the shortage of a component or allied chemical. Obviously, if butyl alcohol is short, then butyl derivatives such as dibutyl phthalate, butyl propionate and butyl acetate will be and are short. The shortage of chlorine, for example, has affected the position of many chemicals that either contain chlorine or require chlorine in their manufacture. Thus trichlorethylene and ethylene dichloride are short, and synthetic butyl alcohol and synthetic amyl alcohols are short partly because of a shortage of chlorine used in the manufacture of these chemicals.

There is little hope that the metal and chemical situation will improve. Although some expansion of production is going on, particularly in the metal producing fields, the projected expansion of the defense effort will probably absorb the increased production. The diversion of products used in one industry to another industry more important to our economy or defense effort has helped and will help to some extent. Thus a portion of the chlorine used in bleaching paper has been diverted to other industries. This diversion could be expanded considerably. Thus, for example, sodium chlorate used in killing weeds could be diverted to more essential uses such as match making and metal treatment.

A feeling of chaos in industry exists over the extreme shortage of materials but small manufacturers and large are making great efforts to get defense business and these efforts are bearing fruit as is evidenced by the results of defense clinics held recently throughout the country. The transition of business from commodity to defense products will naturally decrease the requirements of manufacturers for many materials now short. Unfortunately for the finishing industry as a whole, the amount of finishing operations and materials used on defense equipment and supplies are considerably less than those used on general commodities such as washing machines, clocks, bicycles, automobiles and furniture.

Almost all manufacturers and suppliers of products in the finishing industry have come to realize that to exist they must get more defense business. This business will not come just from manufacturers of airplanes, tanks, guns, etc., but also from the thousands of subcontractors throughout the country. The scramble for this business, in order to carry fixed charges, will mean greater competition in direct selling, advertising, and technical development.

Basic Instruments of Control

The Office of Production Management has endeavored to allocate and control materials in several manners depending upon the relative shortage of the material and the type of user of these materials. Thus materials control has been grouped into several classifications as follows:

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Burrs, polishes metals, plastics, stone, wood or what have you on working surface of 6" by 18". Reduces rejects . . . saves handwork. Wet machine is dustless . . . no over-heating or belt glazing.

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I. Industry-Wide Control

This is a mandatory control of certain classes of materials where complete control is exercised by the Priorities Division over allocation and distribution of raw materials. The specific orders are identified by the prefix "M" and may vary somewhat in detail, but the fundamental purpose is always the same, namely, to put defense requirements uncompromisingly ahead of other needs.

II. Inventory Control

In addition to the materials under mandatory control, the Priorities Division exercises a form of inventory control over certain metals and classes of materials. This form of inventory control requires suppliers of materials under this control, to file a statement of compliance with the Priorities Division and requires customers of suppliers to file monthly statements of compliance with their suppliers.

III. Steel

Steel is in a special class. Iron and steel products are on the Priorities Critical List, subject to inventory control and also subject to the General Steel Preference Delivery Order No. 1.

IV. Priorities Critical List

The Priorities Critical List contains over 300 chemicals and materials and classes of items on which Army and Navy orders can automatically be given priority. Although some of these 300 odd items are under industry wide control, most of them are subject to control only in the sense that Army and Navy orders can automatically be granted priority.

V. Blanket Ratings

One of the instruments being used to speed defense work is the "limited blanket rating order." This order can be given to a company or companies engaged almost wholly in defense work. Such an order assigns a company one rating which applies to all defense contracts or orders for specified scarce materials. Such manufacturers as machine tool manufacturers, crane builders, freight car builders have been assigned these blanket ratings.

VI. Project Ratings

The Priorities Division also issues project ratings from time to time which are similar to limited blanket ratings except that they apply to a project—such as a munitions plant or a dam.

VII. Individual Certificates

These certificates are issued sometimes to certain manufacturers who have had difficulty in obtaining materials or supplies. The manufacturer may be engaged in defense work or may be in an essential non-defense industry.

METALS

ALUMINUM—This is a critical metal and is controlled under several M orders. M-1 directs distribution; M-1-a gives a schedule of preference ratings under M-1; M-1-b modifies M-1 and M-1-a with respect to deliveries of low grade aluminum; M-1-Ext. extends M-1, M-1-a, and M-1-b to Dec. 31, 1941; M-1-c is supplementary order to direct the distribution of aluminum scrap and secondary aluminum.

The requirements for aluminum for the aircraft industry are enormous and will be even greater. Aluminum production in 1939 was 327 million pounds and the present rate of domestic production is about 600 million pounds per annum and the projected requirements for aluminum in aircraft will be over 1.6 billion pounds or more aluminum than was produced last year by the whole world. The production next year expects to reach 825 million pounds per annum and thus there will be no aluminum for non-defense and not enough for all the defense requirements.

ANTIMONY—Antimony comes under Inventory Control, is on the Priorities Critical List and comes under Price Suggestion or Agreement. Only about 10% of this metal comes from mines in the United States. A large portion of our requirements come from Mexico, but larger demands for this metal in lead alloys have made it critical. However, there is sufficient metal for defense requirements and most non-defense uses.

CADMIUM — This metal is in a strained condition inasmuch as it is only obtained as a by-product of zinc refining. Only as zinc production increases will cadmium production increase. Although cadmium is not under mandatory priority as yet, it is controlled under Inventory Control, Price Suggestion and is on the Priorities Critical List. Monthly inventory statements are required and priorities are being given preference. No new customers are being taken by suppliers and old customers are getting amounts based on 1940 requirements. A large part of cadmium produced is used in plating.

COBALT—Cobalt came principally from refineries in Belgium from ores mined in Africa and this source is cut off. One refinery has been built in this country to use African ores and this plus cobalt imported from Canada have relieved the situation somewhat. However, cobalt is tight and comes under Inventory Control and is on the Priorities Critical List.

COPPER—The defense requirements for copper are increasing steadily and there isn't enough for both civilian and defense uses and there is little likelihood that the situation will improve. The estimated 1941 production of copper including imports, domestic production and secondary copper totals 1,650,000 short tons. Military requirements (including foreign) are estimated to be 600,000 tons per annum, essential civilian requirements, 400,000 tons and other civilian requirements 880,000 tons per annum making a 1941 shortage of 230,000 tons. The shortage for 1942 is estimated to be over 700,000 tons. Copper is under Mandatory Priority M-9 and amendments, under General Limitation Order and under Price Ceiling.

CHROMIUM — The condition of chromium is not too discouraging inasmuch as almost a 1½ year supply is at hand and imports are still continuing. The high grade Turkish ores are not available since by agreement Turkey is sending its chrome ores to England. Germany recently tried unsuccessfully to make a trade agreement

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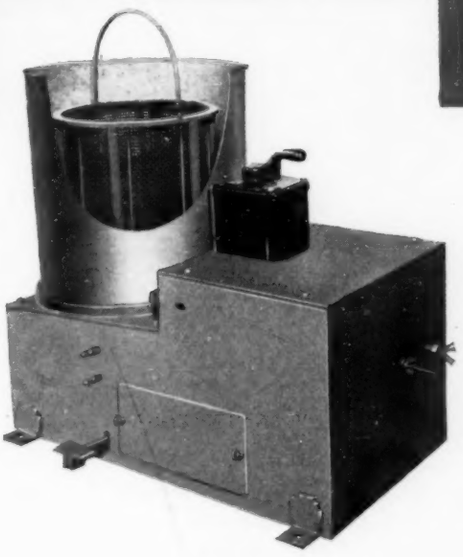

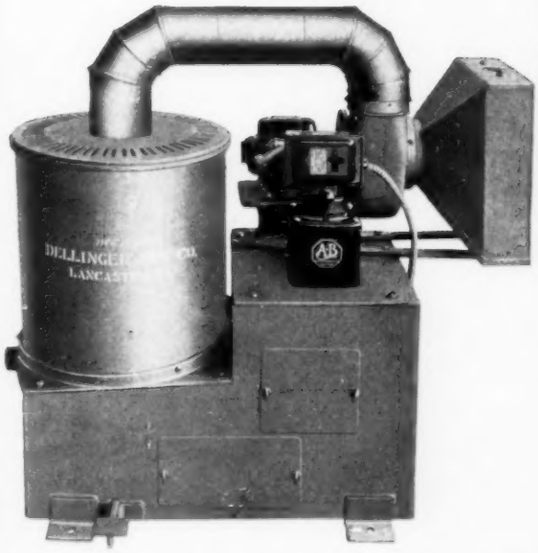

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★Electric welded—all steel construction

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The auxiliary heating unit consists of a steam unit heater with connections for steam line. Air is drawn through this unit by means of a small electric blower and is discharged into the center of the basket. This insures better circulation than is created by the introduction of the air at the sides. The use of this air heating attachment is recommended in drying small parts which by nature retain excessive water or where a cold water rinse is used.

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with Turkey for chrome ore. High grade ores from New Caledonia are reaching us and will be available as long as the seas are free since this source is under the jurisdiction of de Gaulle. Both Cuba and the Philippines have shown considerable promise as chromium producers and fields in Brazil are available. We also have low grade ores in the U. S. which could be handled if the situation became acute. The situation, however, will require careful handling and all non-essential uses for chromium will have to be curtailed. Chromium and chromium chemicals are under Mandatory Priority Order M-18 and amendments. Chromium is also on the Priorities Critical List.

GOLD—This metal with silver is one of the bright spots insofar as availability is concerned because of our gold buying policy in which we have accumulated a large portion of the World's reserves and have stored this metal underground. The Government controls the sale or purchase of gold and has stabilized the price at $35.00 a troy ounce.

IRON and STEEL—The capacity at the present time of our steel producing plants is insufficient to take care of both defense and non-defense needs. It was thought only a few months ago that we had ample steel making capacity but the large amounts now being consumed for defense have made the increase in capacity of steel producing a necessity. A 10,000,000 ton steel expansion program was approved by SPAB recently which will require about two years for completion. The rated capacity of the steel producing industry at present is 86,000,000 tons and in addition there is a 3,000,000 ton expansion underway. The projected expansion will bring the steel making capacity of the United States to 99 million tons per annum, more than double that of the axis powers. Present figures indicate that the demand will exceed capacity by 1,400,000 million tons in 1941 and 6,400,000 tons in 1942 and this explains the reason for the proposed expansion. Steel is under Mandatory Priority M-21 and amendment, also Inventory Control and a special General Steel Preference Delivery Order. It is also on the Priorities Critical List.

LEAD—The position of lead during the first part of the year was good but a great increase in the demands for lead as a result of substituting it for other metals has made the metal harder to get. It is not under mandatory priority although it is under Inventory Control and is on the Priorities Critical List. Our domestic mine output is insufficient to take care of our defense and civilian needs but smelter and refinery capacity are apparently still adequate. About 40% of our consumption is obtained from Mexico, Peru, Canada and Australia. As we go to press, lead was placed under Mandatory Priority Order M-38 (Oct. 4, 1941).

MERCURY—Foreign mercury from Italy and Spain has disappeared from the American market and our consumption which has more than doubled, is being supplied from American sources. We are somewhat behind on our needs for defense and civilian requirements but ore reserves appear to be ample and refinery capacity is coming up to our requirements.

Mercury comes under Inventory Control, Price Suggestion and is on the Priorities Critical List.

NICKEL—The condition of nickel supplies decreased rapidly from the first of the year. Ore reserves are present to cover any desired output but shortages exist in handling facilities, in smelting, and in refining capacity. The elimination of all the choke points in the production of nickel will probably take two or three years and, therefore, there is little hope of the nickel situation improving very soon. In fact, a complete cessation of the use of nickel for civilian purposes may have to take place for some months. We are importing about 15 million pounds of nickel a month and our total requirements are about 20 million pounds a month and, therefore, there appears a shortage of over 50 million pounds for 1941 and this figure may reach 70 million pounds.

Nickel is controlled under Mandatory Priority M-6 which has been extended to March 31, 1942. Nickel bearing alloys are also controlled by other orders. Nickel and nickel alloys are on the Priorities Critical List.

PLATINUM—This metal is available in large quantities as a by-product of the Canadian nickel refineries and large stocks are held on both sides of the border. Iridium, a platinum group metal, is giving worry inasmuch as it is used in contact points and spark plugs. Alaskan sources may take care of our requirements but the jewelry trade may have to use a substitute platinum hardener such as ruthenium. No control is exercised over platinum at present but iridium is on Inventory Control and the Priorities Critical List.

SILVER—Silver offers no problem since we have more than we need for this war and any other emergency. The use of this metal should be expanded. The availability of silver, however, does not mean that its various salts are, because the silver salt condition depends upon other factors such as manufacturing facilities, chemicals used in making the salts, etc.

TIN—The condition of tin is not as critical as was first feared. Although almost all of our tin is imported, we have been able to keep imports slightly ahead of consumption. Present consumption is slightly over 100,000 tons of new tin a year but we have accumulated a stock pile equivalent to 15 months consumption. In addition, a new tin smelter in Texas will be ready early next year to smelt about 19,000 tons of Bolivian and Dutch East Indian ores.

Tin is under Inventory Control and a Price Ceiling.

ZINC—The position of zinc is tight because of insufficient ore and lack of refinery capacity. At present our refineries are operating at a maximum by importing ore from foreign sources but more domestic ore would be available at higher prices. Our zinc production reached an all-time high of 724,000 tons in 1940 and will probably reach 1 million tons in 1942 thus enabling taking care of all defense requirements and 75% of non-defense needs.

THE INSIDE STORY ON THE G-E "500"

Page 9 from the New G-E Booklet

"Copper-Oxide Rectifiers for Electroplating"

THE INSIDE STORY ON THE G-E "500"

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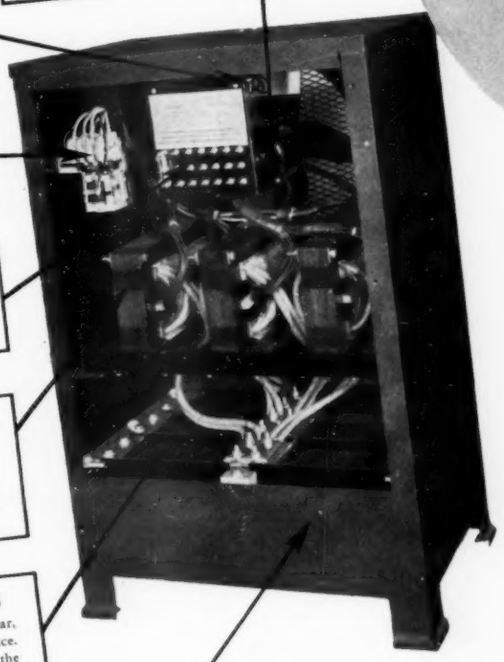

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No moving parts, hence no wear, noise, lubrication, or maintenance. Over sized—compensate for the effects of aging.

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Finest quality electrically-welded all-steel construction. Acid-resisting wrinkle finish. Removable front panel permits easy accessibility to all parts. Designed to permit tier-mounting to conserve floor space.

Investigate the G-E "500." Discover the many money-saving advantages of G-E Copper-Oxide Rectifiers for Electroplating.

G-E Rectifiers provide a decentralized power source for each plating tank... are easily switched to new jobs . . . may be located outside your plating room . . . can be added easily as business expands.

Units connected in multiple will give any capacity required by your business.

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GENERAL ELECTRIC

Zinc is under Mandatory Priority Order M-11 and amendment and is on the Priorities Critical List.

CHEMICALS

ACETONE—Large quantities being taken for defense needs such as in explosive making, plastics, rayon, paint, lacquer, etc. Business is being allocated among non-defense needs. Not enough to supply non-defense demands. Prices firm. Under Price Suggestion and on Critical List.

ACIDS

Acetic Acid—The defense program and civilian demands are heavy for acetic acid. Acid hard to get, both synthetic and natural. Price Ceiling established Sept. 25, 1941.

Boric Acid—The past bad position of boric acid was due to a strike at one of the producers. Improved deliveries have eliminated priorities. Was under Mandatory Priority M-7 and extension which expired August 30, 1941.

Citric Acid—Demand good but somewhat slower than in the past. Suppliers serving usual customers. No restrictions.

Chromic Acid—Market position tight. Under full priority control and General Limitation Order.

Cresylic Acids—Very little imports of this scarce commodity. The material that does arrive is sold at high prices. The use of this material in resins and plastics and the increased demand has created a critical situation and there is little hope of expanding production. On Critical List.

Hydrochloric Acid—Defense demands heavy. Usually selling to customers. No restrictions. No new business taken.

Hydrofluoric Acid — Slightly worse than hydrochloric acid. No restrictions.

Nitric Acid—Same as hydrochloric acid.

Oxalic Acid—Demand for this chemical has been very heavy since the start of the war. It is used in many industries and making pyrotechnic preparations. Imports from Germany have ceased and American production has been expanded to over 10 million pounds this year. No restrictions.

Stearic Acid—Contract business holding and new business active. No restrictions.

Sulphuric Acid—Heavy demand. Selling against contract. No new business.

ALCOHOLS

Amyl Alcohol—Some comes as a by-product of whiskey making. Most from synthetic sources and the chlorine shortage has affected synthetic amyl alcohol production. Material restricted to customers. No priority restrictions.

Butyl Alcohol—The use of butyl alcohol per se and in butyl derivatives such as butyl acetate and dibutyl phthalate has created a shortage of this material. Alcohol is being allocated to contract customers. Comes under Price Suggestion.

Denatured Ethyl Alcohol—Very short. Comes under Mandatory Priority Order M-30 and General Preference Order. The shortage of ethyl alcohol will probably be of the order of 30,000,000 gallons for 1941 in spite of a 35 million gallon increase in production. Price Ceiling also established.

Isopropyl Alcohol—Similar to acetone in scarcity. Under Price Suggestion.

Methyl Alcohol—Under same restrictions as Ethyl Alcohol. Under Mandatory Priority Order M-31.

AMMONIA—Very scarce. Old contracts still being honored for non-defense uses after defense orders have been filled. No restrictions.

AMMONIUM CHLORIDE — White Sal Ammoniac still open for purchase without contract. Imports being received from United Kingdom. No restrictions.

AMMONIUM SULPHOCYANIDE — AMMONIUM THIOCYANATE — Domestic offerings able to take care of requirements. New producers offering material for sale.

AMYL ACETATE—Tight and based on the condition of acetic acid and amyl alcohol. No restrictions.

ARSENIC OXIDE (WHITE) — Supply available. Large imports from Mexico. No restrictions.

BARIUM HYDROXIDE (HYDRATE) —Offerings limited. No restrictions.

BORAX—Improved deliveries have lifted restrictions. Mandatory Priority Order M-7 expired August 30, 1941.

BUTYL ACETATE—Material scarce, offerings limited. Under Price Suggestion.

CADMIUM, CYANIDE AND OXIDE —Not on mandatory priority. Supply limited. Selling to regular customers and defense orders get preference. No new customers.

COPPER SULPHATE—Supplies limited and allocated to customers. No restrictions. Large defense requirements.

COPPER CYANIDE—Supply limited and defense orders filled first. Contracts in some cases for non-defense use also being filled. No restrictions.

CREAM OF TARTAR—Little resale material and producers making market. No surplus supply with makers. No restrictions.

CARBON TETRACHLORIDE—Business is on an allocated basis. Inquiries active but shortage of chlorine affects carbon tetrachloride. No restrictions.

GLYCERINE—Situation is bad and prices frozen at high levels. Shortage due to many defense uses and non-defense demands. Used, for example, in glycerol phthalate resins for finishing, in making rosin ester, and in smokeless powder bags. No restrictions as yet.

HYDROGEN PEROXIDE — Scarcity due to defense needs. Contract customers being supplied with difficulty. No new customers. No restrictions.

NICKEL CHLORIDE—Market short but deliveries have been continuing based on 1940 consumption of customer. Defense orders filled first. No new business taken. No restrictions.

NICKEL SULPHATE—Same as for nickel chloride.

PHENOL—Material short. Imports low, most production domestic. Under Mandatory Priority Order M-27 and on Priorities Critical List. The great demand for plastics, resins for enamels, cleaners and disinfectants has made this chemical extremely short.

Industrial Plating

FILTERS

For Bright Nickel, Nickel, Chrome, Copper Sulphate, Cyanide Copper, Brass, Zinc, Cadmium, High Speed Copper, Brite Zinc, Silver, Electrocolor and others;

Offer You Many Important Advantages . . .

★ **PERFECT CLARIFICATION**
Ultra fine filtration — *GUARANTEED!* Industrial filters offer an ideal system for removal of carbon, clays, or lime from treated solution in process of eliminating iron, organic impurities, oil, etc.

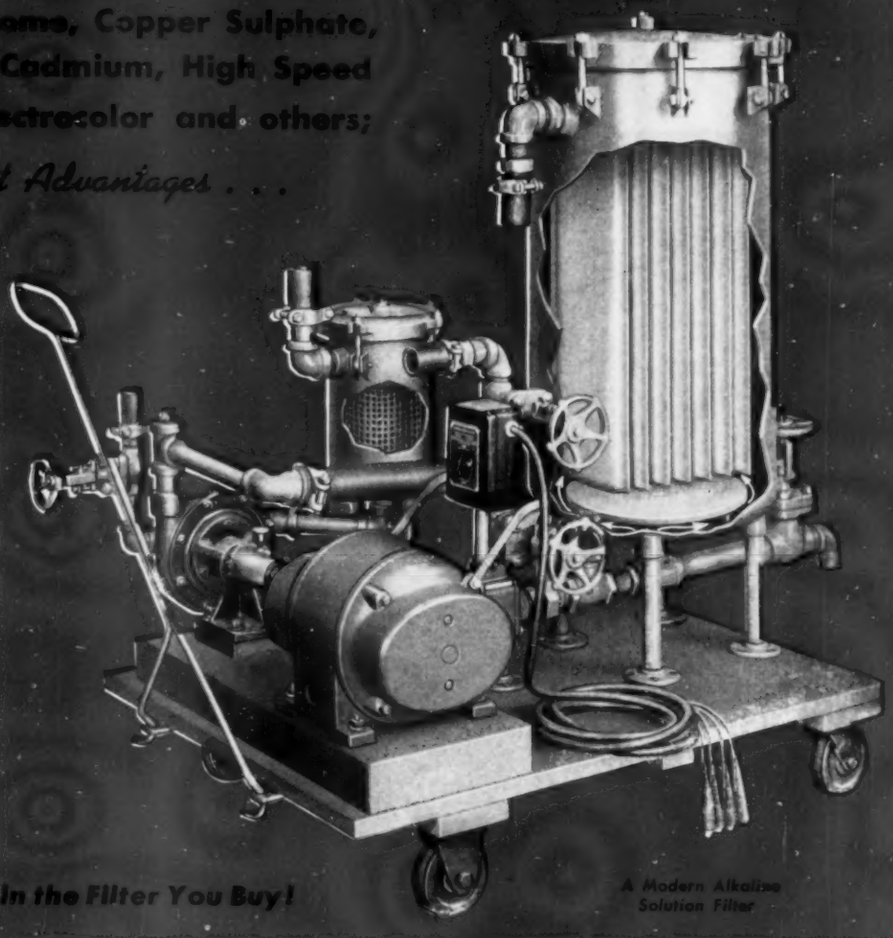
★ **LARGE FILTER AREA**
This feature means rapid action and longer filter cycles. Flow rates are always governed by the filtration area within the filter.

★ **LARGE FILTER CHAMBER**
Means greater sludge holding capacity. A plating filter having a large chamber will not require frequent cleaning, due to becoming quickly packed with sludge.

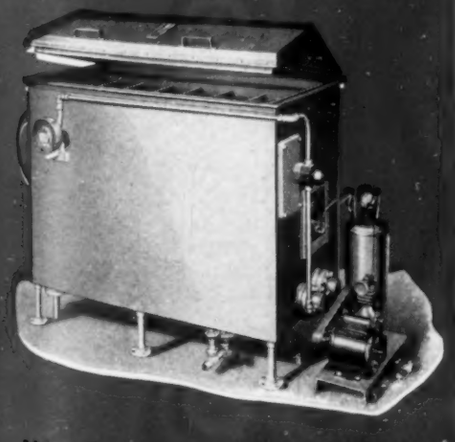
★ **CLOSED FILTRATION**
Filter plates are locked in leak proof chambers. There is no loss of valuable solutions with Industrial Filters.

★ **AUXILIARY SUCTION**
Industrial filters give you a direct means of introducing filter aids in the process of filtering and purifying solutions.

Be Sure *You Get All These Features In the Filter You Buy!*



A Modern Alkaline Solution Filter



SALT SPRAY
Corrosion Test Equipment

A modern instrument for testing electroplated or coated metals at 95 Deg. F. in accordance with the Army, Navy and Aeronautical Specifications as outlined in Bulletin AN-QQ-S 91-5 Dated Dec., 1938. Also for testing at controlled temperatures of any degree. Testing cabinets are lined thruout with high grade rubber.

SALT SPRAY TEST is the standard by which rust resistance is measured.
The quality of plating can be certified and serious losses avoided by checking production with systematic tests. Products tested in this manner enjoy a definite advantage in selling, as the salt spray test now widely used means protection and satisfaction to buyers of plated or coated metals and metal parts.

STANDARD SIZES

No. 1—48" long	**30" wide**	**36" deep**	**No. 3—30" long**	**18" wide**	**30" deep**
No. 2—36" long	**24" wide**	**30" deep**	**No. 4—24" long**	**15" wide**	**30" deep**

We Carry Complete Stocks of Filterbestos, Activated Carbon, Activated Clay, (Super-Filtrol, and Chlor-o-cel) and All Grades of Filter Powder Ready For Shipment

Write for New Literature "FILTERING AND PURIFYING PLATING SOLUTIONS"

INDUSTRIAL FILTER & PUMP MFG. CO.

3017 WEST CARROLL AVENUE — CHICAGO, ILLINOIS

POTASSIUM CARBONATE — POTASH—Deliveries lag behind orders. No restrictions.

POTASSIUM CHLORATE — Under full priority control. Defense needs causing shortage.

POTASSIUM CYANIDE — Domestic production well taken. Serving contract customers. No restrictions.

POTASSIUM HYDROXIDE—CAUSTIC POTASH—Material scarce. Contract customers being taken care of. No new business taken, no restrictions.

POTASSIUM PERCHLORATE — Defense needs great. Under Mandatory Priority M-32. On Priorities Critical List.

POTASSIUM PERMANGANATE — Material short. Under Mandatory Priority Order M-33. Used as a purifier in making alloys for defense.

ROCHELLE SALTS — Position bad due in part to lack of imports of Argol from Europe. Business allocated among regular customers. No restrictions.

SHELLAC—Position not critical as is the case with most materials. Expect demands for shellac to increase greatly due to the necessity for using shellac in place of other resins. No restrictions.

SILVER CYANIDE—Short the same as other metal cyanides due to the condition of sodium cyanide and not due to silver shortage. Contract customers being supplied. No new business taken. No restrictions.

SODIUM ACETATE — Market tight due to the condition of acetic acid. Contract customers being taken care of. No new business. No restrictions.

SODIUM CARBONATE—SODA ASH—Not tight but market is firm. No restrictions. In many cases no new business is being taken.

SODIUM HYDROXIDE — CAUSTIC SODA—Shipments confined to regular customers according to contract. Little new business taken. Very large demand. No restrictions.

SODIUM FLUORIDE — Material scaree. Material allocated among contract customers. No restrictions.

SODIUM CYANIDE—Material short. Defense contracts being filled and some non-defense. No new customers. Very large increase in demand has taken place. No restrictions.

SODIUM SILICATES — Steady and strong demand. Not tight. No restrictions.

SODIUM NITRATE—Inquiry strong. Not yet tight. No restrictions.

SODIUM NITRITE — Strong purchases. Not critical as yet. No restrictions.

SODIUM OXALATE—Heavy demand. Short because of the shortage of oxalic acid. Selling to contract customers. No restrictions.

SODIUM PHOSPHATES—The phosphates are the shortest of the alkalis used in metal cleaners. This is due to several reasons which include great demand, power shortage due to aluminum plants getting preference at TVA

HARD CHROMIUM PLATING

By The Reverse Current Method

U. S. Patent No. 1,645,927

Defense production, where every minute counts, has been quick to realize the advantages of hard chromium plating. The chromium is electroplated directly onto the steel base metal, thereby eliminating the necessity for all copper and nickel plating. In the matter of time-saving and uniformly satisfactory results there is no substitute for the reverse current method of hard plating with chromium—the hardest of all metals.

Write us for information about the licensing arrangement on this process, which is covered by our U. S. Patent No. 1,645,927.

Metals Protection Corporation

RUST PROOF NON-CORROSIVE CHROMILITE PROCESSES PERMANENT FINISHES

Union Title Building, Indianapolis, Indiana

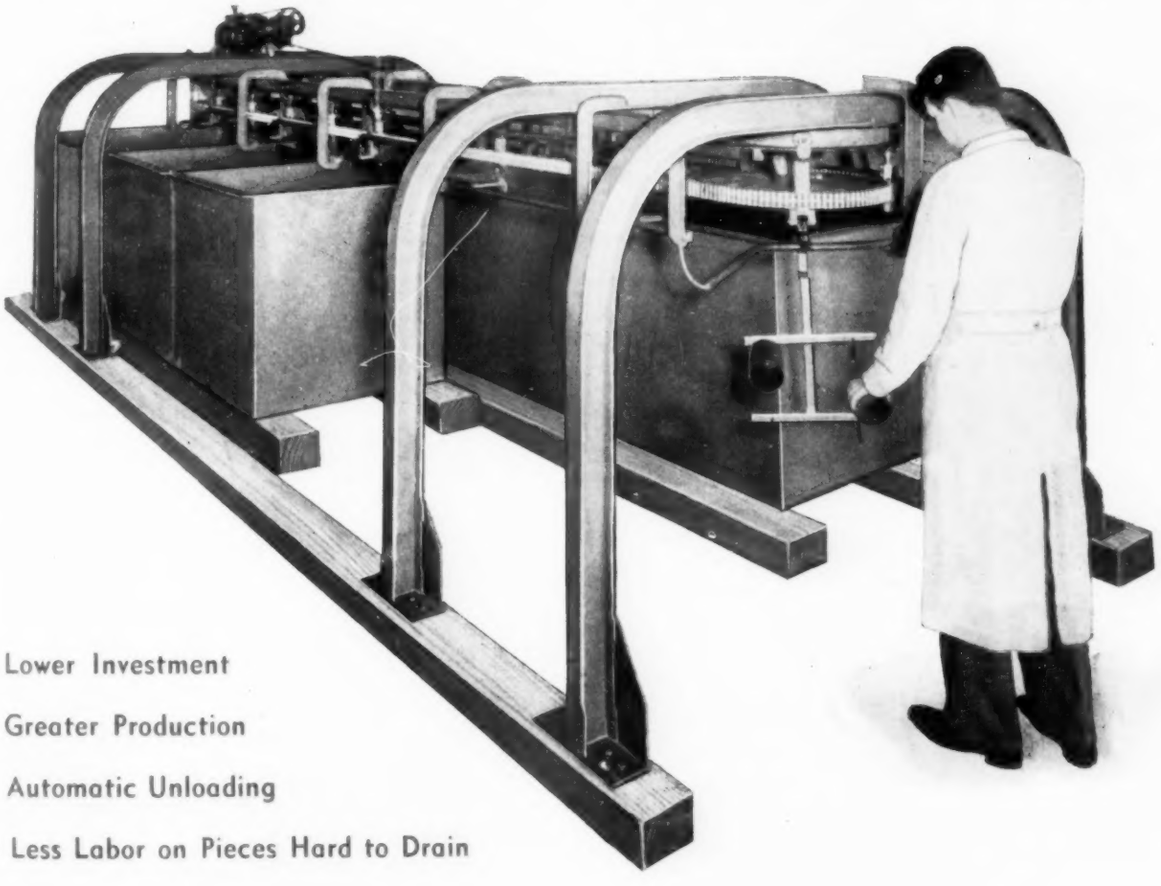
DEAD END

parts such as Cartridges and Shell Cases are easily

CLEANED—PICKLED—BRIGHT DIPPED
OR PLATED

with these

CUSTOM BUILT
AUTOMATIC PLATING CONVEYORS



Lower Investment

Greater Production

Automatic Unloading

Less Labor on Pieces Hard to Drain

LASALCO INC.

2820-38 La Salle Street **St. Louis, Mo.**

and low water due to drought. In addition, the government has taken large supplies of phosphorus. Pyrophosphates appear to be shorter than ortho. Business being allocated among regular customers. No new business being taken. No restrictions placed as yet.

SODIUM STANNATE—Material can still be bought without contract. New orders being taken and many plating plants are putting in sodium stannate plating solutions. Very large increase in demands may make this material short inasmuch as the production is limited.

TOLUOL—Very short due to large demands in explosive making and for finishing materials. Under Mandatory Priority Order M-34. Supplied only on priority order. No relief in sight.

TRICHLORETHYLENE — Material scarce due to shortage of chlorine. Defense requirements being filled and some non-defense orders filled with regular contract customers. Not yet on Mandatory Priority.

TRICRESYL PHOSPHATE and TRIPHENYL PHOSPHATE — Both materials very short coming under Mandatory Priority Order M-16. Shipments are largely against priority orders and little non-defense shipment to contract customers.

V. M. & P. NAPHTHA—Very active demand from paint makers. Demand will probably increase greatly due to changing over to paints and varnishes from lacquers, enamels and synthetics due to shortage of materials for making these finishing materials. No restrictions.

XYLOL—The demand for xylol has been very great due to the heavy demands placed upon toluol. Xylol is used as a substitute for toluol. The available production of xylol, which is limited, is almost largely taken by contract customers and there is almost nothing left for spot business. No restrictions.

ZINC CYANIDE—Scarce due to shortage of zinc and cyanide. Defense orders being filled and a small amount of non-defense business among contract customers.

ZINC CHLORIDE — Shipments confined to regular contract customers. No restrictions.

NATIONAL METAL CONGRESS AND EXPOSITION

At Convention Hall, Philadelphia, Oct. 20-24

THE National Metal Congress and Exposition, combining the metal world's largest industrial exhibit and sessions for principal technological societies dealing with metals, will meet in Philadelphia for five days beginning October 20th.

The 1941 Congress and Exposition will be the largest in the twenty-three year history of the event according to Wm. H. Eisenman, managing director. More than 105,000 square feet of exhibit space have been taken by exhibitors representing every branch of the metals and associated industries. Extensive technical programs of the American Society for Metals, The American Welding Society, the Wire Association and the Iron and Steel division and the Institute of Metals division of the American Institute of Mining and Metallurgical Engineers will be held in conjunction with the show.

Convention Hall and Commercial Museum, Philadelphia

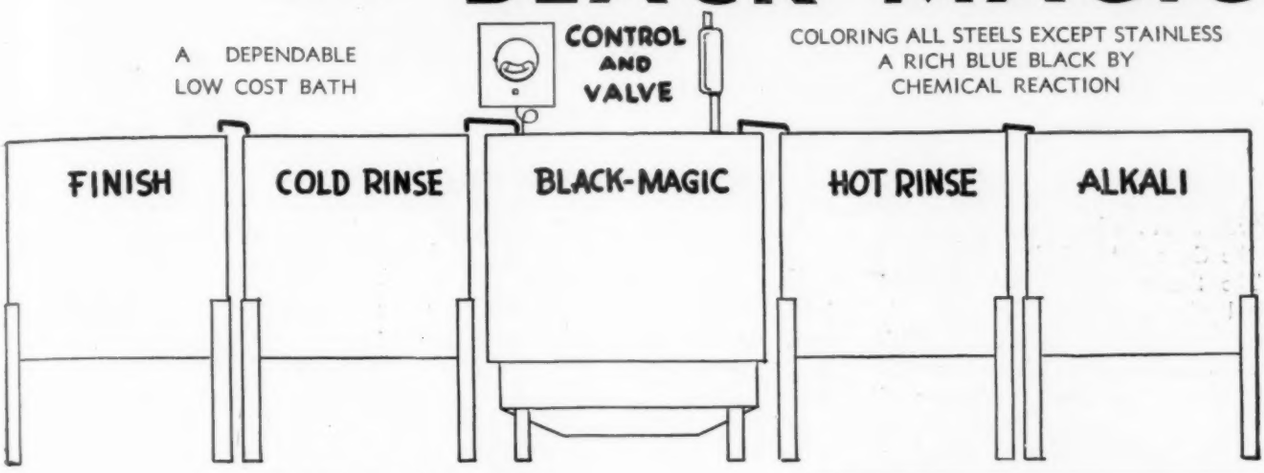
In the Front Line

BLACK-MAGIC

A DEPENDABLE LOW COST BATH

CONTROL AND VALVE

COLORING ALL STEELS EXCEPT STAINLESS A RICH BLUE BLACK BY CHEMICAL REACTION



(LOW COST TANK INSTALLATION)

A Simple ONE Bath Process

Black-Magic Salt is mixed with water and boiled at 300° F. A substantial rust inhibitor.

Excellent substitute for plating, at a fraction of the cost. Our list of satisfied users reads like "Who's Who."

★ *Black Magic products include—* ★

MAGIC ETCH
A dull "Matte" finish.

BLACK-MAGIC
Hi-heat for Iron, Copper and Brass.

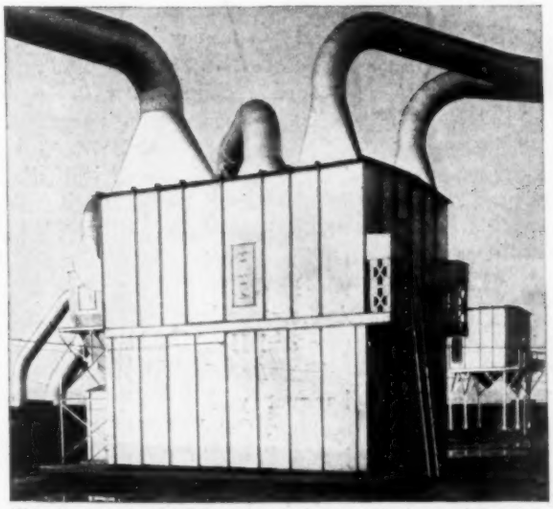
BLACK-MAGIC
Die cast black for Zinc.

WITCH-DIP
★ A paraffin base rust proofing dry finish. ★

THE MITCHELL-BRADFORD CHEMICAL CO. BRIDGEPORT, CONNECTICUT

APPROVED FOR USE ON GOVERNMENT CONTRACTS • SEND FOR COMPLETE PORTFOLIO

HERE'S A PROFITABLE INVESTMENT - -



This Kirk & Blum installation includes a dust arrestor, where fine dust is extracted from the exhausted air. By returning the cleaned air into the building, much heat is reclaimed with consequent fuel savings.

SEND FOR INTERESTING BOOKS

"Dust Collecting Systems in Metal Industries," "Blower Systems for Wood-working Plants," "Fan Systems for Various Industries," "Industrial Ovens."

KIRK & BLUM

DUST CONTROL SYSTEMS

Pay for Themselves •

Effective Dust Control improves working conditions, steps up efficiency, speeds production, makes possible a better product, protects workers' health, cuts maintenance. In addition to these results, KIRK & BLUM Dust Control Systems cost less to operate. Amount of suction delivered and power required are definitely guaranteed in writing — your assurance of satisfactory performance.

Kirk & Blum Engineers, backed by over a third century specialized manufacturing experience, have successfully solved the dust control and fume exhaust problems for many industrial leaders throughout the nation. Why not let them help you? Write for details of this service.

THE KIRK & BLUM MFG. CO. . . . . 2859 Spring Grove Avenue, Cincinnati, Ohio

★ ★ ★

Technical sessions are generally scheduled to be held in Philadelphia hotels as well as at the larger meeting rooms in the Convention Hall.

The theme of the 1941 National Metal Congress and Exposition is "NEW AIDS TO NATIONAL DEFENSE PRODUCTION"—an especially appropriate keynote by virtue of the gigantic defense program now under way. Every item and method to be seen will have direct relation to the preparedness program.

The welding industry will be represented at the metal show by all types of welding: arc, spot and resistance; by gas welding and oxy-acetylene gas and gas cutting equipment. Included in this group are electrodes and electric controllers as well as various grades of welding wire for gas and electric welding.

Heat treating furnaces of all types will be on display: salt bath, annealing-electric, gas and oil fired; induction, atmospheric controlled furnaces of all types and sizes. In addition there will be furnaces and heating equipment for heating rivets and bars, industrial oil heating apparatus and various insulating materials for furnaces and electric heating elements.

In steels visitors will see tool steel, stainless steel, construction steel, valve steel for aircraft and automotive units, heat and corrosion resistant alloys, sheet, strip and high-speed and other steels. These will be shown in finished form and through products made from them.

In the non-ferrous field there will be aluminum, aluminum alloys, magnesium, magnesium aluminum alloys, copper, brass, bronzes, zinc, die casting shapes and forms, non-ferrous wire and other alloys cast and wrought. Machinery for die casting, wire drawing and spring forming will be shown.

The gas industry will be represented by gas fired, heat treating furnaces and many gas heating industrial appliances.

Testing equipment to indicate hardness, tensile, torsional strength, fatigue and many other properties of metals will be demonstrated.

Temperature recording and control equipment will include devices for indicating, recording and controlling temperatures.

Tools of all types will be on exhibit. They include hack saws and files, electric drills, diamond tools, tungsten carbide cutters, diamond test cutters and reamers. Included in this group are abrasive cutting machines and abrasive wheels.

Plating Processes

Plating processes and materials to be shown at the NMCE include plating equipment generators, plating barrels, polishing lathes, induction heating and hardening equipment and methods. Methods in casting will be illustrated, dealing with malleable heat treated and heat corrosion resistant items.

Hundreds of other aids to better production will be shown. They include heat treating salts, carburizing salts, compounds and supplies. Noble metals will be shown in new uses. Handling equipment such as cranes, trucks and hoists are included. Pieces of various optical measuring, metallographic and spectrographic equipment, blue printing machinery and drafting room equipment are to be exhibited. Laboratory equipment to be shown includes polishing machines, chemical determinators and other items for chemistry laboratory work.

Ferro-alloys for production purposes will include nickel, molybdenum, vanadium, chromium, manganese and many other metals in this field.

Fastener items to be shown include nuts, bolts, screws, rivets and lock washers. Hard surfacing alloys for various parts of industrial machinery will be on display.

Petroleum products, quenching oils, rust preventatives and metal cleaning compounds will be show. Sand blast equipment and detergents will be included.

Industrial appliances to be shown will include safety shoes, masks, goggles and other safety equipment as well as water dispensing equipment.

X-ray equipment, turbo compressors and metal cloth are included in the miscellaneous classifications.

Trade and business publications in the metals and associated fields have made arrangements to provide various informational services at their exhibit booths.

Trade and professional associations, allied with the metals field, will be represented by exhibit booths.

Technical programs arranged by the four societies are larger this year than ever before.

Excellent Technical Program

The American Society for Metals' technical program will present 60 papers in fourteen sessions and will include a symposium on "Controlled Atmospheres"; a lecture course to be presented on Thursday and Friday mornings. The ASM National Defense Meetings are described in the accompanying material.

The Edward de Mille Campbell Memorial Lecture will be delivered on Wednesday morning, October 22nd, following the annual meeting of the American Society for Metals. This year's Campbell Memorial Lecture will be prepared and delivered by *Dr. Robert F. Mehl* of Carnegie Institute of Technology.

The educational lectures on the ASM program include daily talks at 5 P.M. to be delivered by *J. B. Austin* of the U. S. Steel Corporation on "Heat Flow in Metals". Three evening lectures in the educational series will be delivered by *S. R. Williams* of Amherst College on the subject "Hardness and Hardness Measurements".

The American Society for Metals banquet will be held on Thursday evening, October 23rd, at Hotel Benjamin Franklin (name of speaker not yet available). Headquarters for ASM will also be at this hotel with morning technical sessions, afternoon and evening lectures to be held at the Convention Hall and Commercial Museum.

The annual fall meeting of the two metals divisions of the American Institute of Mining and Metallurgical Engineers, held during the first three days of the Congress will feature joint

and simultaneous sessions, committee meetings and a round-table discussion on "Order-Disorder Phenomena". Headquarters for the Institute will be at the Ritz-Carlton Hotel.

Approximately 60 papers are tentatively scheduled for presentation by the American Welding Society in its general sessions and in its industrial and fundamental research groups. Headquarters for the AWS will be at the Bellevue-Stratford Hotel.

The Wire Association will present an interesting motion picture "Wings of the Army" in addition to a select list of technical papers and discussions. Headquarters for this society have been announced for Hotel Philadelphian.

This year's National Metal Congress and Exposition will be the largest in history. Hotel reservations are being made direct with hotels in Philadelphia.

The 1940 high of 35,000 attendance is expected to be exceeded at the National Metal Congress and Exposition for 1941.

Exhibitors in the Metal Finishing Field

Abrasive Co., Philadelphia, Booth G-39.

Exhibiting: Grinding wheels and abrasive materials. A balancing ways assembly will be shown illustrating perfect balance of grinding wheels.

In attendance: *R. S. Trimble* and *W. E. Reed*, sales representatives; *D. S. Saurman*, advertising manager, and *W. B. Ilko*, sales manager.

Advance Polishing Wheels, Inc., Chicago. Booth G-34.

Exhibiting: Various polishing and buffing wheels.

In attendance: *J. J. Manderscheid*, president; *John Welhaven*, superintendent, and *George O'Connell*, production manager.

Alox Corp., Niagara Falls, N. Y. Booth 62.

Exhibiting: Polar type rust preventive compounds. Corrosion inhibitors, and petroleum acids for the substitution of animal fats in lubricants.

In attendance: *W. H. Clark*, president; *A. W. Burwell*, vice-president; *J. E. Shields*, research and sales engineer; *H. F. Brewer*, Eastern manager of sales, and *B. G. Spice*, Midwest manager of sales.

Alvey-Ferguson Co., Cincinnati, Ohio. Booth C-54.

Exhibiting: Metal parts washers and miniature model conveyor. The wash machine will have a glass door with marine lights on the inside so that the system of sprays will be visible.

In attendance: *Donald P. Smith*, in charge of exhibit. Others to be present: *J. C. Walter*, president; *M. Van Billiard*, eastern division manager; *C. L. Koehler*, general manager; *Ray Merz*, washing machine department, and *Harry J. Ferguson*, Philadelphia representative.

American Foundry Equipment Co., Mishawaka, Ind. Booth D-61.

Exhibiting: A 27"x36" Wheelabrator Tumblast and a No. 1 Wheelabrator Multi-Tablast. Work which is being cleaned for defense industries will be shown.

In attendance: *Otto A. Pfaff*, president and general manager; *Leslie L. Andrus*, vice-president in charge of sales; *Vern S. Spears*, sales department, *Charles E. Benham*, district sales manager; *James Rigby*, district sales manager, and *A. E. Lenhard*, advertising manager.

American Rolling Mill Co., Middletown, Ohio. Booth F-31.

Exhibiting (in operation): Sheet metal products in defense preparations. Electropolishing will be shown on chromium stainless steels; also formed enameled ware and many other metal products, and information.

In attendance: *G. F. Ahlbrandt*, assistant vice-president; *J. P. Butterfield*, manager; *F. A. Tobitt, Jr.*, and *John Owen*, stainless steel sales department; *Anson Hayes*, director; *Reed Kenyon*, associate director, and *B. F. Finkbone*, products engineer of research laboratories; *C. F. Feledy*, *W. A. Kuenzel* and *F. B. Dechant*, sales engineers; *R. A. Dadisman*, manager; *R. M. Nelson*, market development *div.*; *F. A. Tobitt*, manager of Eastern sales dept.; *A. M. Wortley*, manager, and *F. S. Campbell*, Philadelphia office.

Baker & Co., Inc., Newark, N. J. Booth G-43.

Exhibiting (in operation): Platinum laboratory equipment; platinum and platinum clad chemical equipment; precious metal themocouples and protection tubes; blowerless tool room laboratory and atmospheric furnaces; also platinum resistance coal ash analysis furnace.

In attendance: *H. J. Russell* and *L. C. Burman*.

Black & Decker Mfg. Co., Towson, Md. Booth 44.

Exhibiting (in operation): A complete display and demonstration of portable electric tools applicable to metal processing and finishing. This will include power assembly tools, such as screw drivers and nut runners, a complete line of abrasive tools, including portable grinders, sanders and buffers, as well as electric shears for cutting sheet metal, electric drills of various sizes and accessories to these various groups of processing equipment.

In attendance: *Eric Federschmidt*, manager, Philadelphia branch; *Frank Cassidy* and *Ralph Herrick*, salesmen; *G. M. Buchanan*, high cycle sales engineer, and *J. F. Apsey, Jr.*, advertising manager.

The Bristol Co., Waterbury, Conn. Booth 66.

Exhibiting (in operation): Control instruments for high and low temperatures in the heat treating of metals and other materials.

In attendance: *L. G. Beane*, vice-president and general sales manager; *H. E. Beane*, field sales manager; *C. W. Bristol*, chief engineer; *F. W. Borchers*, Philadelphia district manager; *R. M. Walker*, manager field engineering department; *L. E. Mustard*, Detroit district mgr.; *F. J. Reynolds*, New England district manager; *C. Webber*, New York district manager, and *G. H. Gaites*, Pittsburgh district manager.

Brown Instrument Co., Div. Minneapolis-Honeywell Regulator Co., Philadelphia. Booth 63.

Exhibiting (in operation): Indicating, recording and controlling instruments and accessory equipment used in the production and heat treating of both ferrous and non-ferrous metals.

In attendance: *E. B. Evleth*, vice-president and general manager; *L. M. Morley*, vice-president and general sales manager; *K. R. Knoblauch*, assistant general sales manager; *J. R. Green*, manager, steel div.; *J. E. MacConville*; *H. M. Schmitt*, Philadelphia industrial manager; *J. R. Simpson, Jr.*; *G. H. Larkin*; *L. J. Benson*; *A. Potts*; *O. B. Pyle*; *W. J. Brosch*; *R. Schlegel*, and *R. S. Ferguson*.

Carborundum Co., Niagara Falls, N. Y. Booth 236.

Exhibiting: Abrasive and refractory products.

In attendance: Grinding wheel div.—*F. J. Tone, Jr.*; *S. F. Courter*; *B. H. Work*; *W. J. Griffith*; *A. H. Prey*; *H. J. Wills*; *C. L. Hall*; *H. L. Henszey*; *E. C. Maguire*, and *Paul Raguse*. Refractory Div.—*F. W. Miller*; *J. G. Fritzinger*; *J. A. King*; *R. A. Barr*; *C. E. Hawke*, and *A. A. Turner*. Globar Div.—*B. A. Bovee*; *K. E. Rogers*, and *C. E. Barba*.

Colonial Alloys Co., Philadelphia. Booth G-11.

Exhibiting: Process for plating upon aluminum, for welding aluminum and various other metal treating processes.

Despatch Oven Co., Minneapolis, Minn. Booth 4.

Exhibiting: Ovens for organic finish baking and heat treating.

Detroit Rex Products Co., Detroit. Booth 282.

Exhibiting: Two-dip, hand-operated and electrically heated degreaser in operation

to demonstrate the rapid and efficient removal of oil from metal products in industrial processing. Various industrial alkali cleaners and products cleaned by this method will be shown. Charts and diagrams of a new oil extraction process for the removal of oil from soya beans, etc., will be shown. Finishes, plastics and other items made from these oils will be exhibited.

In attendance: *W. W. Davidson*, vice-president in charge of sales; *D. E. Williard*, sales manager industrial div.; *W. F. McCracken*, research engineer; *P. B. Ruppe*, manager Philadelphia div.; *W. T. Day*, sales engineer, and *G. W. Walter*, adv. and sales promotion manager.

Foxboro Co., Foxboro, Mass. Booth F-12.

Exhibiting (in operation): Indicating, recording and automatic controlling pyrometers of various types will be demonstrated, as well as other instruments widely used in heat treating processes. Recording and non-recording controllers will represent the wide range of control systems of both the pneumatic and electric types, which are available in various models to meet the requirements of any process or application.

In attendance: *C. E. Sullivan*, general sales manager and vice-president; *S. C. Horn*, manager metal industry sales; *J. Esherick*, district manager, Philadelphia; *A. H. Shafer*, district manager, Pittsburgh; *C. E. Hellenberg*, district manager, Detroit; *Harvey Lee, George Hammer, F. S. Walter* and *H. A. VanDyke*, sales engineers.

Gehnrich & Gehnrich, Inc., Woodside, L. I., N. Y. Booth M.

Exhibiting: A direct gas fired recirculating type air heater, such as is used on japanning and enameling ovens; also a small convection type heat treating oven.

In attendance: *William Gehnrich*, president; *Charles L. Gehnrich*, vice-president; *Charles A. Gehnrich*, secretary, and *Herman Gehnrich*, treasurer.

Handy & Harman, New York. Booth C-40.

Exhibiting: Working demonstration of brazing alloys. A photographic display of 50 jobs for defense. Samples of welded parts.

In attendance: *F. T. Van Syckel*, in charge; *H. A. Folgner*, industrial engineering dept.; *J. C. Powers, Jr., H. D. Lucas, M. C. Robbins, A. W. Swift*, sales engineers; *Leo Edelson*, development engineer, and *F. Petrie*, laboratory technician.

E. F. Houghton & Co., Philadelphia. Booth 60.

Exhibiting (in operation): Products for processing metals for National Defense. A blackening process, rust protective compounds, forging agents, drawing compounds, lubricants and leather packings will be included.

In attendance: *G. W. Pressell*, executive vice-president; *E. C. Barlow*, assistant director sales; *H. E. Sanson*, sales manager, Eastern Div.; *James McElgin*, manager metal technical sales; *R. M. Quintenz, technical* sales department; *C. H. Stonerod, R. W. Richmond, R. J. McCormack, J. A. Patch, S. T. Dolan, R. L. Wickes, G. W. Esau, S. D. Margerum, O. H. McClay, C. E. Kite, J. F. Weber; R. J. Swing, J. R. Clendenning* and *F. J. Ramsey*, sales representatives.

Independent Pneumatic Tool Co., Chicago. Booth C-21.

Exhibiting (in operation): Portable electric—drills, screwdrivers, nut setters, sanders, grinders, saws, hammers and nibblers.

In attendance: *J. A. Hill*, Philadelphia district manager; *N. C. Hurley, Jr.*, vice-president; *W. A. Nugent*, vice-president; *J. B. Dempsey, V. G. Turner, E. Hammett, E. R. Wyler*, New York district manager; *C. N. Kirchner*, advertising manager; *F. H. Charbono, E. R. Gee, Lewis Abbott* and *W. D. Trainor*.

Jackson Buff Co., Long Island City, N. Y. Booth H-6.

Exhibiting: Airway ventilated buffs.

In attendancance: *John F. Harper* and *A. B. Stafford*.

Chas. F. L'Hommedieu & Sons Co., Chicago. Booth E-44.

Exhibiting: Variable speed lathes, generator sets, rectifier, rheostats, plating barrels, buffs and compositions, and also tank magnets.

In attendance: *Arthur W. L'Hommedieu*, president; *S. L. Cole*, vice-president; *H. M. Writer*, representative; *O. M. Shoe*, Philadelphia representative; *Chas. B. Little*, Newark representative.

Leeds & Northrup Co., Philadelphia. Booth 20.

Exhibiting: Recording controller and carburizing method to be demonstrated, as well as other control instruments for heat treating.

Maas & Waldstein Co., Newark, N. J. Booth A-15.

Exhibiting: Lacquers and synthetic enamels used on defense materials. Finishes to take the place of those using aluminum powder. Finishes for drying with infra-red radiation also shown.

MacDermid, Inc., Waterbury, Conn. Booth G-46.

Exhibiting: A number of articles for which MacDermid, Inc., have developed special cleaning processes. These will include brass cartridge cases, machine gun parts; also compounds themselves and descriptive literature.

In attendance: *Henry A. Strow*, chief chemist; *Harold Leever*, western manager and *W. D. MacDermid*, vice-president and sales manager.

Manhattan Rubber Mfg. Div. of Raybestos-Manhattan, Inc., Passaic, N. J. Booth B-13.

Exhibiting: Abrasive cut-off machine with rubber bonded cut-off wheels.

In attendance: *F. E. Lyons*, Philadelphia representative; *T. C. Carey*, demonstrator, and *W. H. Steinberg*, assistant manager, abrasive wheel department.

The Matchless Metal Polish Co., Chicago. Booth G-34.

Exhibiting: Non-ferrous metal compositions; greaseless composition for cutting down; Tampico and wire brushes. Buffing compositions for use on brass, copper, aluminum, stainless steel, zinc die castings, lead die castings, bronze, plastics, rubber, celluloid, wood and plated ware.

In attendance: *H. S. Kelshaw*, division manager; *J. W. Varick*, field engineer; *W. H. Torrance*, and *W. D. Mildern*, sales department.

Milburn Co., Detroit. Booth H-37.

Exhibiting (in operation): Exhibit of materials for industrial skin protection used for prevention of industrial skin irritations caused by toxic chemicals. Also material for protection of precision finished metals from corrosion caused by hand perspiration.

In attendance: *G. M. Cole* and *D. L. Green*, factory representatives, and *J. A. Stifter*, president.

Norton Co., Worcester, Mass. Booth 290.

Exhibiting: Abrasive wheels, refractories and polishing grain.

In attendance: *W. R. Moore*, general sales manager; *W. T. Montague*, assistant vice-president; *G. A. Park*, Eastern sales manager; *R. Kirkpatrick*, sales manager, refractories div.; *A. G. Green*, chief sales engineer; *V. H. Ericson*, sales engineering department; *W. J. Bell, H. C. Steele, F. E. Leiby, C. W. Jinnette, A. Seymour*, district manager, Philadelphia; *A. W. Gough, J. D. Laughrey, W. A. McCune, Jr.*, and *C. M. Nyden*.

Oakite Products, Inc., New York. Booth 226.

Exhibiting: Improved method of preparing aluminum and alloys for electrolytic resistance spot welding. Products will be shown for washing iron and steel parts in tank or by machine. Other products for cleaning before pickling, tinning and galvanizing. Rust proofing materials, grinding compounds, burnishing and tumbling compounds will also be shown.

In attendance: *H. L. Gray*, vice-president; *J. J. Basch*, Philadelphia and Southeastern division manager; *George Seib* and *E. Lingle*, New York office; *E. C. Rinker*, metals section, Oakite Research Laboratories; *H. P. Jacques, C. S. Anderson, E. B. Scheirey* and *C. C. Armstrong*, service representatives.

Ohio Carbon Co., Cleveland, Ohio. Booth F-39.

Exhibiting: Carbon and graphite and metal graphite, brushes for motors, generators, welders, etc. Burnishing tool

for commutators and rings to be shown.

In attendance: *F. C. Aurand*, secretary; *Dr. I. W. Brandel*, sales manager; *J. F. Ehlers*, district representative and *H. A. Hurlbut*, district representative.

Packer Machine Co., Meriden, Conn. Booth H-6.

Exhibiting: A Packer No. 4-5 station rotary "Packer-matic" buffing machine and a No. 424 continuous rotary and a No. 8500 oscillating wheel head. Equipment will be with fixtures and chucks as in an actual polishing and buffing job. Finished samples will be displayed and factory time studies will be available.

In attendance: *Kenneth Levenselor, Eugene Phillips*, factory trained sales representatives, and *C. I. Packer*, part time.

Pangborn Corp., Hagerstown, Md. Booth C-46.

Exhibiting (in operation): Blast cleaning and dust control equipment, featuring treatment of shells. Rotoblast cleaning also will be shown.

In attendance: *V. F. Stine*, vice-president; *A. L. Gardner*, advertising manager; *J. H. Connolly*, New England district manager; *W. F. Jones*, New York City district manager; *F. G. Sharpe*, Philadelphia district manager; *R. M. Trent*, Pittsburgh district manager, and *B. R. Artz*, Syracuse district manager.

Park Chemical Co., Detroit. Booth 279.

Exhibiting: Heat treating products; also buffing compositions, polishing and wheel cement.

In attendance: *W. P. Woodside, Sr.*, president; *J. N. Bourg*, vice-president and general manager; *H. I. Dixon*, assistant general manager; *R. N. Lynch, J. C. Thompson, W. P. Woodside, Jr., F. J. Staral* and *J. P. Clark, Jr.*, metallurgical sales engineers; *R. W. Luzius*, grain cement and buffing composition service engineer.

Phillips Mfg. Co., Chicago. Booth 266.

Exhibiting (in operation): Portable degreasers and portable still.

In attendance: *W. D. Phillips*, president; *J. M. Bash*, treasurer; *R. A. Van Fossen*, engineer; *Erben Jenkins*, engineer; *G. R. Angrave, William Printz, A. C. Hamer, Lyman Lloyd, Bernard P. McCafferty, R. K. Ridgeway* and *E. F. Koch*, sales engineers.

Porter-Cable Machine Co., Syracuse, N. Y. Booth A-37.

Exhibiting (in operation): A demonstration of wet and dry belt grinding, disc and spindle grinding, electric saws, sanders and grinders.

In attendance: *F. A. Hurd*, experimental engineer; *F. C. Poulsen*, field engineer; *K. O. Ditmars, J. G. Wells, J. G. Ray, M. H. Rochelle*, sales engineers, and *H. L. Ramsay*, sales manager.

Pulmosan Safety Equipment Corp., Brooklyn, N. Y. Booth H-35.

Exhibiting: General line of safety equipment, such as respirators for dust, fumes, and other safety devices used in manufacturing.

In attendance: *Fred Wahlert, B. C. Wetterholm, Karl Bahret, T. E. Neill, Frank Rodak* and *E. W. Burke*.

N. Ransohoff, Inc., Cincinnati, Ohio. Booth B-10.

Exhibiting: Automatic equipment for cleaning, pickling and burnishing metal.

Standard Steel Spring Co., Coraopolis, Pa. Booth 203.

Exhibiting: Various type objects treated with the Corronizing process, including, screen, outboard motor parts and golf equipment.

In attendance: *Richard Rimbach*, technical advisor and *T. N. Berlage*, sales manager, Corronizing division.

C. J. Tagliabue Mfg. Co., Brooklyn, N. Y. Booth 225.

Exhibiting: Control equipment.

Wheelco Instruments Co., Chicago. Booth 41.

Exhibiting (in operation): Combustion safeguards and models of most instruments made by the company.

In attendance: *R. A. Schoenfeld*, vice-president and sales manager; *T. A. Cohen*, vice-president and chief engineer; *J. F. Wade*, Philadelphia district manager; *D. A. Campbell*, New York district manager; *J. A. Ariano, Herbert Proske*, and *George W. Hall*, Boston district manager.

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ELECTROLYTIC ETCHING

By Samuel Wein

New York

Introduction

ETCHING of metals for name plates, signs and decorative purposes is by no means new. The generic methods are commonly known and in use for several centuries, but somewhat refined in detail with respect to modus operandi. It is not the purpose of the present text to discuss these methods, but rather that method in which the metals are etched electrolytically, i.e., the direct opposite to the electrolytic deposition of metals. The electrolytic etching of metals is supposed to be kept as a "trade secret" among those actively engaged in this art, and if that be the case, it is hoped that the following text will be the means of generally interesting others in that phase of electrochemistry and so the public at large will benefit.

Electrolytic etching of metals is by no means a difficult procedure, it is akin to electroplating, the only difference in the latter case is the fact that the "work" is made to serve as the *cathode*. By the term *work* I refer here of course to the metal about to be etched.

Electrolytic etching has many advantages over the common methods now in use and these may well be summed as: (1) faster, (2) cheaper, and (3) a finer grained background. None of these claims can well be made by the conventional methods.

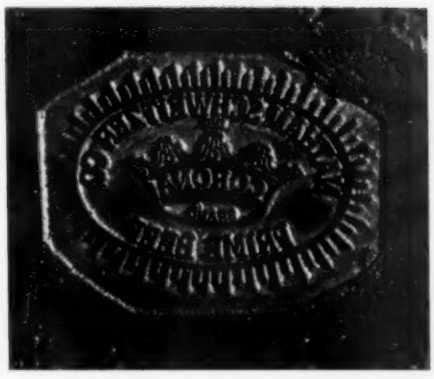
The procedure is to first secure a flat and cleaned piece of metal, and onto it is painted, drawn, or by photographic means formed an "etch resist." Subsequently the etching is resorted to by means of a suitable etching compound. Once a desired etch depth has been attained, the work is considered to be finished, and the etch resist is removed by means of a suitable solvent. Obviously, of course, there are little tricks as is the case in every art and industry. This is best considered to be "technique" which cannot be described, and must be acquired, like experience, and this can only be had with trial and after trial until this technique has been mastered.

Operations in Process

Now that we have a common idea or understanding of the etching conditions that are necessary, we shall discuss in detail every phase of the subject matter as practised by the author and several commercial shops.

Herewith follows an outline of the necessary steps prior to and up to the point of etching.

An etch resist is formed on the metal. This may be done by means of a pen, brush or photographic means, depending of course on the nature of the details to be etched on the metal. Since the present process deals with the *photographic resist* we shall of course confine our discussion to that phase of the subject matter.



Steel die etched electrolytically using salt solution and following technique described in this article. Sharp etching with a minimum of undercutting is possible.

(1) A pen and ink drawing is made on a sheet of paper and a photographic negative is made therefrom.

(2) The metal plate about to be treated is first made chemically clean, for two good reasons, and these are (a) that the etch resist will adhere tenaciously to it, and (b) to permit proper electrolysis thereafter. This cleaning may be carried out by scrubbing the surface of the metal with a suitable powder or to the action of any suitable cleaning compound the plater is accustomed to use. Subsequently washing in running water, and exercising care not to allow finger marks, dust or other foreign particles to collect on its surface, as otherwise it will have to be recleaned.

(3) The cleaned metal surface is now coated with a thin film of the photographic etch resist and which is allowed to dry.

(4) The photographic negative is now brought in contact with the photograph etch resist and placed in a "printing frame" which holds the two together. The metal plate with the photographic etch resist film and the negative in contact therewith is now exposed before a strong light for as long a period of time as is necessary to make the *print* or *exposure*, and the two (metal plate and negative) are separated.

(5) The *exposed metal plate* is now developed as the case may require, depending, of course, on the kind of etch resist used. What actually happens is that the exposed

portions of the etch resist have become insoluble in that specific *developer*, whereas, those portions of the etch resist not affected by the light depending of course on the negative in front or contact with it, are washed away in the developer, exposing the metal surface.

(6) The sides and the back of the metal plate, as well as those portions of the metal that are not to be etched must be "stopped off" with a suitable resist as otherwise the exposed portions too will be etched.

(7) An electrical contact is made to the back of the metal plate.

(8) The plate so treated is now placed in a strong solution of sodium chloride, and electrolysis is set up at the exposed metal portions of same.

(9) The sides of the etched metal are now "powdered" or stopped-off, and again electrolysis is resorted to (etching). This step may be carried on until such a depth of etching has been reached as is desired.

(10) The metal plate is now washed with running water and the etch resist is dissolved or disposed of with a suitable solvent, and the metal plate is now ready for use.

The Metals Used

The metals commonly used with electrolytic etching are copper, brass and steel. Other metals have been tried, but that is still experimental, and as such, the details need not be considered or discussed here.

The Etch Resist

Any material that is unaffected by the electrolytic action of a strong solution of sodium chloride will serve our purposes. Another requisite is that it must be able to form homogenous films on a metal plate and that it will become insoluble in the presence of potassium or ammonium bichromate. Such a resist can be found in the use of (a) glue, (b) natural resins and (c) synthetic resins.

In the case of glue, the most popular and commonly used glue is a refined grade of fish glue. The natural resins are shellac or gum arabic, and of course, the synthetic resins which are miscible with aqueous or organic solvents are likewise commonly used.

There are a number of concerns actually serving the planographic arts with prepared photographic etch resists.†

Etch resist emulsions, like platers solutions, vary from worker to worker, i.e., in respect to specific proportions of the ingredients used. However, here is one typical formula that has been in use with a number of practical men and over a period of more than ten years. It is made up of two solutions, viz:

1.	Glue	9 fluid oz.
	Water	16 " "
2.	Water	8 " "
	Ammonium bichromate	1½ oz.

Solutions 1 and 2 should be well mixed in order that the ingredients properly dissolve, and then are carefully filtered so as to dispose of any lumps or foreign matter along with dirt particles.

After these simple steps have been taken, solutions 1 and 2 are mixed, and the mixture is then ready for use.

† Names furnished by *Metal Finishing* on request.

Some workers usually allow this solution to stand for at least 24 hours, in order to permit it to "age," when it is supposed to work better.

Shellac Compound

A modification using shellac as the base in the etch resist is made up of:

Shellac	250 grams
Castor oil	20 "
Methanol	500 cc.
Propanol	700 "
Isobutyl alcohol	200 "
Caustic soda	4 grams

To the foregoing solution is added up to 10 per cent of a 10 per cent solution of ammonium bichromate.

IMPORTANT. This mixing of ingredients should be carried on in a room where there is no direct sunlight, as otherwise the solution will become affected by the light and will be rendered useless for further use.

Preliminary Treatment

As one might expect, the metal surfaces will not permit proper adhesion of the emulsion if they are dirty or greasy, as is the case in electroplating. In order to avoid difficulty such as "lifting," proper cleaning must be resorted to. The oil may be removed with any of the customary cleaning compounds (degreasing), and subsequently rubbed with water and a very finely powdered pumice. This latter gives the surface a sort of "tooth," permitting the adhesion of the emulsion thereto. During this process of cleaning and rubbing with the pumice, great care should be exercised to avoid possible scratching as otherwise this will be apparent in the finished etched plate.

After the cleaning and rubbing process just outlined has been carefully done, the work is washed with running cold water, and once again care being taken to avoid finger marks over the surface, as this will prevent the adhesion of the light sensitive emulsion.

Coating the Plate

Onto the metal surface, immediately after it has been cleaned and rubbed as previously described, is poured a little of the light sensitive etch resist. The procedure is to pour this in the center of the metal plate, and to slightly tilt it in order to permit the film to properly cover the entire surface.

This is usually carried on in a room where there is no direct sunlight.

In order to properly do such a coating job, a slowly revolving table may be used. In such a fashion, a thin and homogenous film of the emulsion is formed on the surface of the metal plate.

Printing

The metal plate with the emulsion is now placed in contact with the photographic negative, and locked tight into the printing frame.

In the larger shops, in order to insure intimate contact between the negative and the metal plate with the emulsion,

a "vacuum printing frame" is used. Here the air is pumped out, bringing the negative and the metal plate into excellent contact with one another.

The printing frame is now exposed to a strong source of illumination, such for instance as a carbon arc. The time period is usually in the neighborhood of three to five minutes, and the distance between the printing frame and the arc lamp is about eighteen inches.

In the case where no arc lamp is had, the use of sunlight may be resorted to. The printing time period may vary anywhere up to 15 minutes, depending of course on how strong the sun is at the printing time. This factor may best be ascertained by a test.

Developing

After the plate has been properly printed, it is now "inked up." This is done merely by, (a) painting the surface with what is commonly termed as "developing ink," or by (b) rolling the surface up with the ink, in the same fashion one does with a roller over type.

The plate so treated is now placed in the sink and cold water is permitted to flow over the entire surface. What actually takes place is this, those portions of the plate that have not been affected by the light are soluble in the water and wash away, whereas those portions that have been affected by the light become insoluble (is said to be mordented), and will continue to adhere to the surface of the metal (plate).

"Burning In"

In order to insure further adhesion of the emulsion to the metal surface, bearing in mind that the emulsion will be treated very roughly during the subsequent steps, the film or *image* on the metal plate is burned into the surface of the metal plate. This step is carried on by placing it on an ordinary kitchen gas stove. The inked image will be seen to melt and fuse itself into the surface of the metal plate. Here great care must be exercised once again in this step as otherwise the emulsion or film can be burnt off. In order to prevent this from happening, the plate should be slowly manipulated over the flame with dexterity.

The Cathode

In this case, an insoluble electrode should be used. The most popular of these are lead or graphite plates.

"Undercutting"

After the *first bite* or etch about 0.001" down, the walls of the etched surface will likewise etch out and this thinning of the walls will reduce the tensile strength of that portion of the etched plate. This is overcome by building up the walls of the surface merely by brushing the walls with what is commonly termed as "dragons blood," a resinous material. This is done by brushing the walls with the dragons blood and burning it in at low temperatures and then again resorting to etching for another 0.001" or more, and once again re-etching. This can be resorted to as many times as one may choose, at least until the desired etch depth has been attained.

The Etching Solution

Ordinary sodium chloride (table salt) is dissolved in water. The concentrations will vary from a 10 per cent solution up to a concentrated solution. The more dilute solutions give finer grained etched surfaces and a longer time of etching, whereas in case of a stronger solution, a coarser grained metal etch is had and less time for so doing is required.

Voltage

For copper and brass, use is made of between 8 and 10 volts, and in the case of steel, the voltage is between 5 and 6 volts.

Current

Between 1 and 2 amperes per square inch of etching area are used, and the current density depends directly on the rate of speed of etching as well as the concentration of the sodium chloride solution. Actual experience has shown that the faster the speed of etching, the coarser will be the surface of the metal (back-ground).

Agitation

In order to attain ideal etching results, the solution is best agitated by means of (a) compressed air, or (b) by means of a paddle. On the other hand, the metal piece to be etched may be revolved or moved as is the case in fast electroplating methods.

Temperature

Room temperature is always recommended, since the etch resist may "lift" from the metal plate surface at increased temperatures.

Etching Time

Approximately one-thousandth of an inch in the case of copper and brass in one minute can be etched. In the case of steel approximately one half of one-thousandth to three-quarters of a thousandth of an inch per minute is considered to be good time.

When George Washington was 18 years old or in the year 1750, buttons of silver were being made by a silversmith of Waterbury, Conn.

Old Egyptian and Syrian money, made of bronze about 3000 B.C. may be seen in the wonderful coin collection on display at the Chase National Bank in New York City. These pieces were made in the form of a ring for convenience in carrying on a stick or strung on a heavy thread.

The first coin struck by the United States Mint in Philadelphia is on exhibition at the Federal Hall Memorial Museum in the Sub-Treasury Building on Wall Street, New York City. It is a half dime. It was struck in the presence of President and Mrs. Washington in 1792. The coin was presented to the President's wife, and is now embedded in the head of a cane, made from a part of a tree that grew over Washington's grave.

FINISHING THE BELL AIRACOBRAS

By John W. Welty

Process Engineer,
Bell Aircraft Corp.,
Buffalo, N. Y.

John W. Welty

THE almost fantastic demands that have been made on the aircraft manufacturer in the past year have necessitated many new innovations in the fabrication of his product. Not the least of the headaches encountered has been the necessity of keeping many thousands of detail parts flowing smoothly and evenly through his finishing department.

Consider that the small pursuit airplane is composed of upwards of 9000 individual parts and 54,000 rivets, and that larger types of planes have a proportionally larger number of parts. All these parts are fabricated from the lightest and strongest alloys available. Remember, too, that the designer has pared every excess ounce of weight from these components, and it becomes apparent that even a slight amount of corrosion simply cannot be tolerated. Consequently class A-1 protective coatings must be afforded to all units of construction.

Materials of Construction

Before discussing how the finish problem is handled at the Bell Aircraft Corporation, it seems desirable to give some consideration to the various classes of metals that are used. Also their corrosive characteristics and the nature of the protective coatings that must be applied to them. These materials fall into four main classifications:

1. Copper Base Alloys
2. Iron Base Alloys
3. Aluminum Base Alloys
4. Magnesium Base Alloys

They rank just about as listed in the matter of corrosion resistance, with copper alloys having the highest rating and magnesium alloys the lowest. Each of the above classifications could be broken down into many subdivisions— prima-donnas for special applications—but for the purpose of this article this is unnecessary.

Aluminum alloys comprise by far the greatest per cent of the weight of the modern military airplane. Pure aluminum is, in itself, remarkably resistant to corrosive action, but does not possess sufficient strength to make it usable in the structural components of aircraft. However, when aluminum is alloyed with small amounts of such elements as copper, magnesium, manganese and silicon, the result is a material which may be fabricated in the soft state and subsequently heat treated to a very high strength. The same is true of rivets—they are made from aluminum alloy wire and are heat treated to produce the desired physical characteristics.

Unfortunately, however, these high strength alloys of aluminum display a marked decrease in resistance to corrosion as compared to commercially pure aluminum. Consequently finish coatings of high protective value are called for. A high strength aluminum alloy sheet is available which has thin surface layers of commercially pure aluminum rolled on its surfaces at the mills. This aluminum really constitutes a protective coating in itself, since this type of material has all the high strength properties of uncoated sheet plus all the corrosion resistance of pure aluminum. Moreover, this aluminum coating has a higher electric potential than the underlying alloy and thus pro-

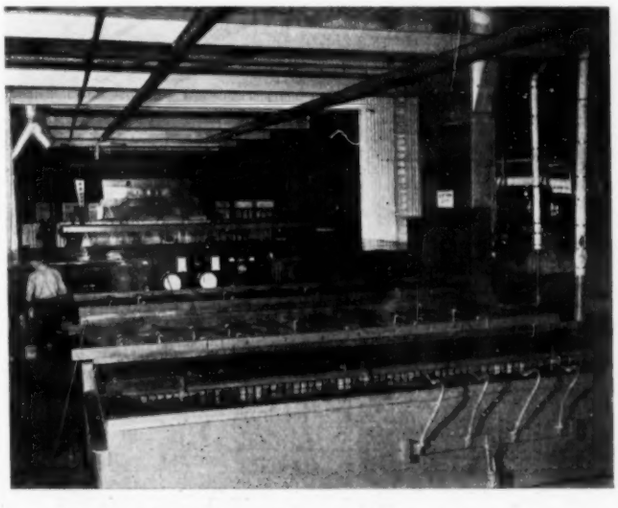


Fig. 1. Photograph of two anodizing tanks. The center tank is a hot water rinse.

John W. Welty was born in New Philadelphia, Ohio in 1902. He graduated from Philadelphia High School and Georgia School of Technology. He became associated with the airplane industry in 1929 as assistant metallurgist for Curtiss Airplane and Motor Co. of Buffalo. He spent several years in Turkey and China being employed by the Air Ministries of those countries to help establish factories and manufacture American type aircraft. He has been with Bell Aircraft Corp. as Process Engineer, since 1939.

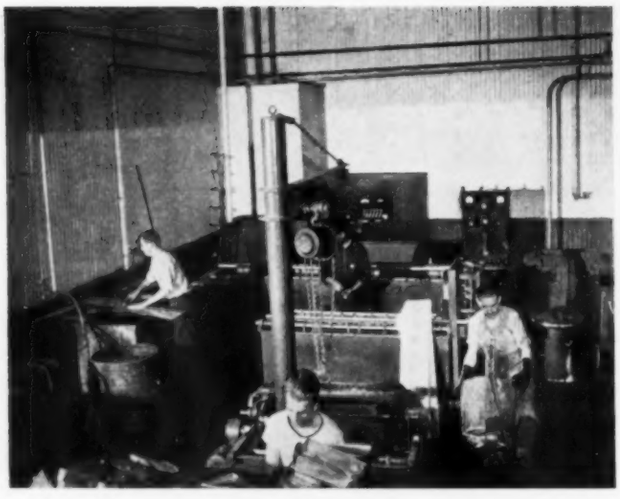


Fig. 2. A corner of the cadmium plating department showing barrel plating unit in foreground and plating tanks in rear.

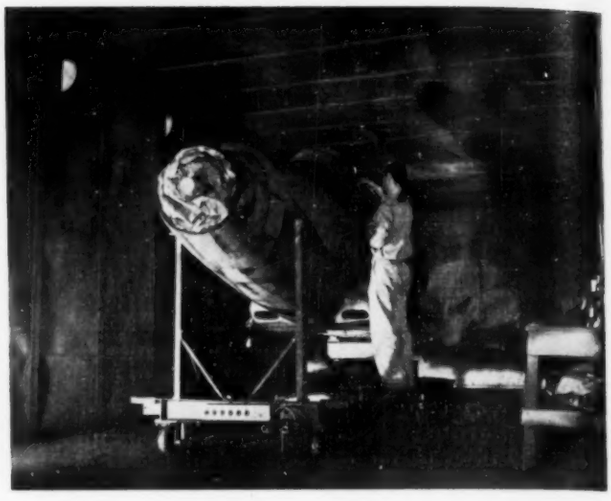


Fig. 3. Workmen applying camouflage finish to a Bell "Airacobra" fuselage.

tects sheared edges and drilled holes by virtue of electrolytic action. For example, if any dirt or moisture comes in contact with such areas, corrosion proceeds at the expense of the aluminum coating rather than the strong underlying alloy. Therefore, parts fabricated from such aluminum coated alloys normally require less protective coatings than those fabricated from uncoated alloys.

Surface Treatments

Both the United States Army Air Corps and the Navy Bureau of Aeronautics require that aluminum alloys used in aircraft construction be given an oxidation treatment. This is accomplished in either a solution of chromic or sulphuric acid. The aluminum oxide coating forms a thin film over the surface of the parts when they are made the anode in the solution by applying a D.C. voltage across the tank. This process is commonly known as "anodizing". These oxide coatings serve a double purpose. First, the corrosion resistance of the alloy is stepped up immensely. Second, an excellent base for paint coatings is obtained. The thickness of these oxide formations depends upon the conditions under which they are formed, but at the greatest it is the range of one or two ten thousandths of an inch.

These oxide coatings are applied in a manner that they will meet the requirements set forth in Army-Navy Specification AN-QQ-A-696. This specification outlines the performance requirements of parts that have been anodized, and leaves the exact method, and process control of the solutions to the discretion of the manufacturer. Specification requirements are that such anodic treated parts shall withstand exposure for 720 hours to a 20% sodium chloride solution at 95°F. The method of carrying out this accelerated corrosion test is detailed in Army-Navy Specification AN-QQ-S-91. At the conclusion of the exposure, the parts are examined for evidence of corrosive attack. If any doubt exists as to whether the material has successfully passed this ordeal, physical tests are compared with those made on uncorroded specimens.

The Bell Aircraft Corporation uses the chromic acid process for the formation of these oxide coatings. For various reasons, this process finds more favor in the aircraft industry than the sulphuric acid process, although both are widely used. The chromic acid process is fairly well standardized throughout the industry. However, there is some difference of opinion on the best solutions, concentrations and methods of control.

Anodizing tanks used at the Bell factory are 16 feet long, 4 feet wide and 7 feet deep. They are set in pits with about three feet rising above the floor level. Each contain 3000 gallons of chromic acid solution. Heating of the solution is accomplished by steam coils in the bottoms of the tanks. Water cooling coils are also installed in the tanks, and in addition cold water spray on the outside. The latter is necessary because the solution tends to overheat under heavy loads. The heating and cooling system is automatically controlled. D.C. motor generator sets furnish the current for the anodizing cycle.

New solutions are made up by using 0.4 pound of technical grade of flake chromic acid (CrO_3) for each gallon of water

Operating temperature	95°±4° F.
Voltage	40
Time of treatment	30 minutes

The complete cleaning and anodic treating cycle consists of the following operations.

1. Degrease (combination vapor and spray degreasing tank)
2. Hot water rinse
3. Rack
4. Anodize for 30 minutes
5. Hot water rinse

Laboratory analyses are made of the chromic acid solutions for chromic acid content, sulphate content, chloride content and pH. Additions and corrections are made to the solution as indicated by these analyses. A study is being conducted as to just what effect the aluminum content (which builds up in use) has on the solution ultimately becoming inoperative, but no reliable conclusions have yet been reached.

The color of the oxide film formed by the chromic acid process varies with composition of the alloy that is being treated. High purity aluminum takes on a light gray color,

Fig. 4. Workmen removing parts for airplanes at the unloading end of monorail conveyor system.

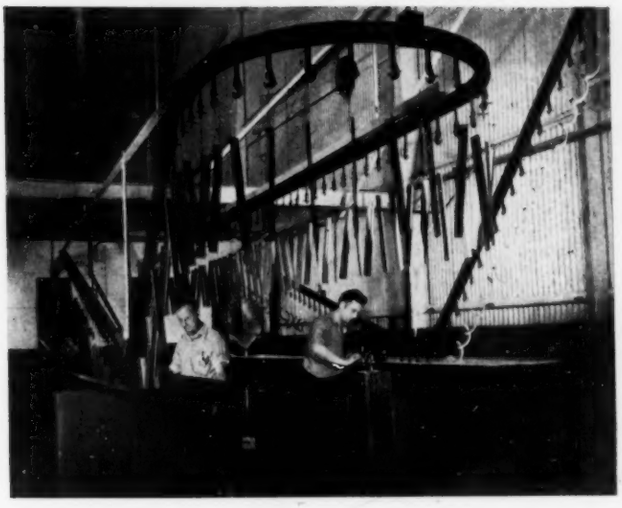


Fig. 5. Work passing through organic finishing dip tanks. Left tank contains lacquer; right tank, primer.

whereas other of the alloys turn a dark gray. Aluminum silicon alloys come out a grayish-black color. The quality of the oxide film may be judged to some extent by the color of the finished work, provided it is definitely known what the material composition is. Weak or spent solutions, or faulty operating conditions have a tendency to produce work which reflects a variety of rainbow hues on the surface—reds, greens, blues, etc.

Chromic acid formed aluminum oxide films have excellent electric insulating properties. Therefore a quick estimate can be made of the quality of the work produced by means of a low voltage electric circuit and lamp. If the lamp fails to light when a piece of treated work is inserted in the circuit, it is evidence that a good oxide coating has been obtained.

Color evaluation, the electrical method, and the accelerated corrosion tests are used at Bell Aircraft Corporation for judging the quality of oxide films formed. However, only the latter actually constitutes a performance test, while the former two merely indicate ability or disability to pass this test.

Illustration No. 1 shows two anodizing tanks. The center tank is a hot water rinse. To the left (not shown in picture) are located vapor degreasing tanks, and additional chromic acid and rinse tanks. In the background can be seen generators and control panels. Directly above these, a loaded rack of work moves forward to be put in the tank in the foreground.

Magnesium Base Alloys

With the development of magnesium base alloys during the past twelve or fifteen years, a variety of surface treatments have been developed with the view of increasing their inherently low resistance to corrosion. The current series of magnesium alloys are more resistant to corrosive attack than those which existed a few years ago, but they still must be given a good surface treatment and first class organic protection if they are to perform satisfactorily in service.

One of the most commonly used surface treatments is accomplished in acid dichromate solutions. This is known as "chrome pickling". Solution composition is

Sodium dichromate ($Na_2Cr_2O_7.2H_2O$)	1.5 lb.
Concentrated nitric acid (sp. gr. 1.42)	1.5 pints
Water to make	1 gallon

New solutions have a specific gravity of 1.20 at 80° F. With use, the specific gravity increases to 1.235 when the solution must be re-acidified with nitric acid to a gravity of 1.27. It is then satisfactory until the gravity increases to 1.305. At this stage, it is re-acidified a second time to 1.335 specific gravity. When the gravity finally increases to 1.37, the solution is discarded. (The above figures are from the American Magnesium Corp.)

The bath is operated at normal room temperature. Time of immersion in the solution is one to two minutes. Parts are rinsed in cold water and hot water, then dried. Paint coatings are applied immediately. The cleaning cycle prior to treatment is:

1. Degrease
2. Hot alkaline dip
3. Hot water rinse
4. Cold water rinse

Parts which are heavily oxidized or have imbedded grease and dirt, are given a fifteen second dip in a solution composed of eight parts of nitric acid, two parts of sulphuric acid, and ninety parts of water.

When magnesium is welded, all welding flux is at once scrubbed from the parts with a still brush and warm water. Welded areas are chrome pickled immediately by brushing on the acid dichromate solution.

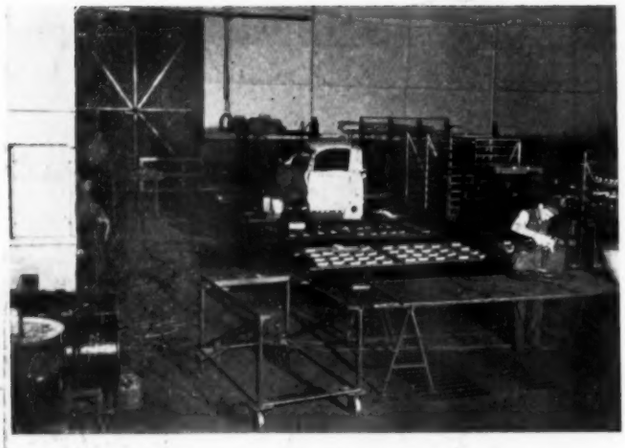


Fig. 6. Shows a number of parts laid out for spraying. Overspray is exhausted through the grating.

Cadmium Plating

Iron and copper base alloys are cadmium plated for protection against rust and corrosion. There is no set way of cleaning all parts prior to the plating operation. Parts from the heat treating furnaces are shot blasted to remove heavy scale and oxide. Barrel tumbling and hand scrubbing with powdered pumice stone are resorted to when necessary. The normal cleaning and plating cycle for parts is:

1. Degrease
2. Anodic clean
3. Hot water rinse
4. Cold water rinse
5. Acid dip (20% muriatic acid)
6. Cold water rinse
7. Cadmium plate

The time in the plating tanks is adjusted to give a thickness of cadmium of 0.0005". About half this amount is deposited on threaded parts. Current densities are regulated so that the cadmium coating is lustrous, finely crystalline and adherent. The plating solution composition is

Cadmium	3 oz./gal.
Sodium cyanide	9 "
Sodium hydroxide	1 "

After plating, parts are given a dip in a 5% solution of chromic acid. This neutralizes traces of alkali remaining in the pores after plating and increases paint adhesion. Small springs, and parts subject to flexure are heated to 375° F. for three hours to remove traces of hydrogen remaining in the metal after plating. In certain cases, premature failure of very hard parts has been traced to hydrogen embrittlement.

Army-Navy Specification AN-QQ-P-421 outlines the requirements for cadmium plated parts. Such parts must withstand 250 hours exposure in a salt spray box without showing rusting of the base metal. Cadmium plated test samples and parts are given this accelerated corrosion test in the Bell Laboratories.

Illustration No. 2 shows a corner of the cadmium plating department. At the right, a workman removes a load of small washers and nuts from a barrel. In the rear, two still plating tanks are seen. Specially designed racks carrying a number of cadmium balls can be mounted on tanks when internal plating is required.

Organic Coatings

Up to this point, the discussion has been confined to metal surface treatments and cadmium plating. The second phase of aircraft finishing will now be taken up—namely, organic coatings.

With the demand for production and still more production occasioned by the defense program, the Bell Aircraft Corp. has standardized on a few types of high quality organic coatings for finishing their airplanes. Quick drying materials are preferred.

Zinc chromate primer is first applied to all surfaces that are to be painted. This type of primer is covered by Army Air Corps Specification 14080 and Navy Specification P-27B. Much has been written and said concerning the excellence of chromium compounds as corrosion inhibitors. It will suffice to point out here that zinc chromate primer to these specifications is not only an excellent corrosion preventative, but also affords top coat adhesion. Some of the more important properties of this primer are (as enumerated in Specification 14080):

It shall be suitable as a protective coating for metal surfaces when used alone or with finishing coats of enamel, varnish or lacquer.

Pigment—The pigment content of the primer shall not be less than 30% by weight. The composition of the pigment shall be as follows:

Zinc chromate	85% minimum
Extender	15% maximum
Pigment Analysis	
Zinc, calculated as ZnO	33% minimum
Chromium, calculated as CrO_3	35% minimum

Flexibility—The primer shall withstand bending over a 1/8" rod.

Gasoline Resistance—The primer shall withstand immersion in gasoline for four hours.

Working Properties—The primer shall show satisfactory spraying qualities and form a satisfactory undercoat for lacquer and enamel.

Zinc chromate primer is thinned with toluol to the desired consistency for spraying or dipping. This is on the order of two parts toluol to one part of primer.

The top coats used at Bell are pigmented nitrocellulose lacquers. As with the primers, they are purchased to government specifications so that a high quality product is assured. Army Specification 3-158 lists the following properties for nitrocellulose lacquers.

Blushing—The lacquer shall have sufficient resistance to the precipitating action of high humidity to prevent the formation of streaks and discoloration.

Non-Volatiles—The non-volatile content of the pigmented lacquers shall not be less than 40%, and for clear lacquer shall not be less than 30%.

Water Resistance—The dried lacquer film shall withstand cold water for 18 hours.

Gasoline Resistance—The dried lacquer film shall withstand gasoline (aviation domestic grade) for 18 hours.

Bend Test—The lacquer shall withstand bending around a 1/8" rod after baking at 200° F. for four days.

Self Lifting—The lacquer shall show no tendency to self lift.

Weathering Test—Test panels sprayed with pigmented lacquer shall withstand six months outside summer expo-

sure without checking, cracking, fading, or showing other defects.

Before any finishing materials are purchased, samples are subjected to very searching examination by Bell Laboratories. It is especially necessary to accurately know drying times and settling qualities of materials used since constant speed conveyor systems carry the parts through the finishing cycle.

The protective coatings described heretofore are applied for a single purpose—namely, for the prevention of corrosion and rust under service conditions. The defense program has led to the development of an organic coating applied for another purpose—that of camouflaging the airplane. These camouflage coatings are put on the outer surfaces of the fuselage, wing and tail groups after these units have been assembled. Two different types of materials are in general use—flat nitrocellulose lacquers, and synthetic enamels. Bell uses both types. These camouflage finishes are allowed to dry normally without the application of heat. The materials are formulated so that they have a very low reflectivity and a high degree of smoothness. Undercoatings of zinc chromate primer are used. The synthetic types of enamel are thinned with toluol, while a special lacquer thinner is used for the nitrocellulose material.

If the camouflage scheme is complicated, fabric templates are used to define the areas on wings and fuselage where the colors are to be applied. When only a two color scheme is used, the lines of demarcation between colors are blended together by overspraying at the lines of demarcation. Illustration No. 3 shows a workman applying camouflage finish to a Bell "Airacobra" fuselage in spray booth used exclusively for this purpose. Cabin glass and gear box have been masked. This particular airplane will be delivered to the Army Air Corps. It will receive one thin coat of zinc chromate primer and two coats of camouflage lacquer.

Application of Protective Coatings

Detailed drawings of airplane parts show the finishing scheme that shall be applied to these parts. This finish scheme is put on the drawing in accordance with a previously prepared specification. From the drawings operations, cards are made up which accompany the parts through the factory. Thus it is that the finishing department know the particular finish that is to be applied when parts are delivered to them.

Now let us turn our attention to the factory and see the set up that has been made at Bell Aircraft for handling many thousands of parts daily. Perhaps this can best be accomplished by tracing some typical parts through the finishing department. A group of aluminum alloy parts affords a good example. The card tells the operator that these parts are to be anodized, zinc chromate primed and lacquer top coated.

First, they are put into a large mesh wire basket and lowered into the degreasing tank. Upon removal, they are moved to the head of the anodizing line. Here the parts are assembled on aluminum alloy hooks, wires and clamps and hung on the cross bars of the anodic rack. An overhead travelling conveyor picks up the rack and moves it to the proper anodizing tank. The parts, which hang below the rack, are immersed in chromic acid solution. The positive side of the electric circuit is quickly plugged into the rack. Illustration No. 1, nearest tank, shows method of making this connection.

When the anodize cycle is completed, rack and parts are hot water rinsed and dried, and are moved to the loading end of a monorail conveyor system. Here the parts are hung on hooks attached to the moving chain. When they return to the starting point thirty minutes later, they have been zinc chromate primed, lacquer top coated and dried—ready for assembly into airplane units. Illustration No. 4 shows a workman removing parts at the unloading end of the monorail conveyor system. The sequence of operations that the parts are carried through by the chain conveyor is:

1. Zinc chromate prime (dip tank, mechanically agitated)
2. Bank of infra-red lamps (to quickly dry primer)
3. Nitrocellulose lacquer (dip tank, mechanically agitated)
4. Bank of infra-red lamps (to dry lacquer)
5. Unload

Time between operations 1 and 3	6 minutes
Time between operations 3 and 5	13 minutes
Withdrawal rate from dip tanks	4 feet per minute
Conveyor speed	12 feet per minute
Hook spacing along chain	6 inches

Assuming that parts are of such size that every hook is filled, the capacity every twenty-four hours of each such monorail system is: $\frac{12 \times 60 \times 24}{0.5} = 34{,}560$. The above described conveyor system is also used for applying paint coatings to cadmium plated parts. Illustration No. 5 is a view of work going through the dip tanks. Left tank contains lacquer; right tank, primer. Each is equipped with a fire extinguishing system. In the enclosure in the background are located the infra-red ray baking lamps.

There is also a variety of work, which for reasons of size, shape or special finishes required, cannot be handled on conveyor systems. This is sprayed in the conventional manner. Atomized paint is exhausted from the room by means of a down draft system which first carries the air through a water wash and then exhausts it out through the roof. Illustration No. 6 shows a number of parts layed out for spraying. In the center an Airacobra cabin assembly is being masked prior to painting.

After assembly of various units of the airplane, they are touched up with a second coating of lacquer to repair areas where the finish has been marred. Rivet heads are also painted at this time. These operations are necessarily done by spraying.

It has been the attempt of this article to list and discuss the processes and materials which find the greatest use in finishing the Bell Airacobra Airplanes. In addition to these there are a number of special finishes used which have a highly important function, but whose application is more or less limited. Copper and chromium plate, acid proof lacquers, tank sealing compounds, and heat resistant finishes are examples of these. Bell research engineers are constantly investigating these problems and are ever on the alert for new methods, better materials and means of simplifying manufacturing processes.

Analysis of Chromic Acid Anodizing Baths

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THE chemical control of the sulphuric acid process electrolyte for anodizing is relatively simple. However, in chromic acid anodizing baths, the chromic acid is capable of entering into combinations forming various complex compounds, and the analysis of the solution becomes more difficult. Previous investigations on anodizing in the chromic acid electrolyte have been carried out on a laboratory scale with solutions ranging from 3 to 10% of chromic acid by weight[8,9] but in no case has the original concentration of free chromic acid been maintained at a constant value for the entire life of the bath. It is my belief that the variable introduced by the transformation of free chromic acid to chromates, bichromates, and trivalent chromium salts should be better understood and controlled. At least, the free chromic acid concentration should be maintained at a constant value for the life of the bath.

Definition of Anodizing and Anodizing Requirements for Aircraft

When aluminum is made the anode or positive electrode in certain electrolytes, an oxide film is formed on its surface. This process is known as anodizing. The aluminum oxide film, ranging in thickness from one-half millionth to eight hundred millionths of an inch[1,2,3] has many desirable properties, the most important, as far as the aircraft industry is concerned, being its high resistance to abrasion and the adherence offered for paint.[4]

The latter property makes the combined anodic coating and paint finish the most desirable treatment for aluminum from the standpoint of corrosion resistance. For this reason, it is required by specification on all surfaces exposed to atmospheric corrosion on Naval aircraft[5]. Less severe weathering conditions on Army[6] and commercial land planes require anodizing on a smaller number of parts.

Of the various electrolytes in use, such as sulphuric acid, oxalic acid and chromic acid, the chromic acid has been adopted by all or the majority of aircraft companies operating in the United States.

Chromic Acid Process

The process as it is used at present is described in the Army Air Corps Specification 98-20005-B and, briefly, consists of immersing the cleaned aluminum parts in a solution of 5 to 10% chromic acid (CrO_3) by weight, at a temperature of 95° F. plus or minus 4° for a period of 30 minutes at a potential of 40 volts, the aluminum being the anode or positive electrode and the steel tank the cathode during the electrolysis. This specification has been superseded by Specification AN-QQ-A-696[7] which only requires that specimens anodized withstand the salt spray test[10, 11] for at least 720 hours and allows the contractor a free hand in the development of his own process and gives him the choice of either sulphuric acid or chromic acid for the electrolyte.

The Army Specification 98-20005-B contained a paragraph which called for the addition of chromic acid to maintain the required concentration due to dragout losses. No method for the analysis of the electrolyte and no recommendation for the anode to cathode ratio (ratio of surface of the work to the inside surface of the tank) was prescribed. These two factors are very important variables and explain why anodized specimens from various aircraft factories did not always pass the salt spray corrosion test called for by the specification, although seemingly operating under the same conditions.

† Presented at June 11, 1941 meeting of Los Angeles Branch, American Electroplaters' Society.

Anode to Cathode Ratio

R. W. Buzzard and J. H. Wilson[8] have shown that the reduction of the chromic acid in the electrolyte is affected by the anode-cathode ratio, less chromic acid being reduced at higher ratio values. In plant practice, when the anode loads or the work in the tank varies from load to load and from plant to plant depending upon the habits of the operator and the type of clamps used, the operator using heavier loads will find that he can get better results operating under lower concentrations of actual or free chromic acid, and even obtain satisfactory results when the acid concentration is below 2%, than an operator anodizing with the same concentration of chromic acid in solution when employing lighter loads. Also, the operator who is using heavier loads will find that less chromic acid additions are required during continuous operation of his tank.

The above is due to the fact that chemical equilibrium of the electrolyte is altered, a greater anode or oxidizing area having a reversible effect on the electrolyte as shown by the following equation:

$$8\ CrO_3 \rightleftharpoons Cr_2\ (Cr_2O_7)_3 + 3\ O$$

A smaller anode surface has the opposite effect, that of making the reaction go to the right and robbing the solution of chromic acid which Buzzard and Wilson of the Bureau of Standards hold responsible for the anodizing action[8].

To obtain uniform operation, the chromic acid content must be kept constant. This requires a simple and reliable method of analysis.

The pH method which is proposed by Buzzard and Wilson[8] has not proved satisfactory in plant operation, nor have the more difficult iodometric and ferrous ammonium sulphate oxidation methods. The latter two require an additional aluminum determination in order to arrive at an approximate chromic acid content.

The method which I hereby propose is simple and reliable.

ANALYSIS OF CHROMIC ACID

(*Anodizing and Chromatizing Solutions*)

Reagents

1. Standard sodium hydroxide (about 1 N. NaOH).

Special Apparatus

1. pH meter (glass electrode).

Procedure

1. Pipette 25 ml. of the solution into a 250 ml. beaker and dilute with water to 100 ml.
2. Stirring continuously, titrate the solution using the pH meter and record the ml. of NaOH solution required to bring the solution to pH 3.2 and pH 4.8. The NaOH solution should be added cautiously in the region of the desired pH, since a very small addition will cause a large increase of pH values at these points.

Calculations

Let A = ml. of NaOH solution to pH 3.2
B = ml. of NaOH solution to pH 4.8
N = normality of NaOH solution

1. Chromic Acid (CrO_3)

$$\frac{}{AN\ (0.4)} = \text{gm./100 ml. of } CrO_3$$

2. Alumina (Al_2O_3)

$$\frac{}{BN\ (0.68) - AN\ (0.694)} = \text{gm./100 ml. of } Al_2O_3$$

3. Total Hexavalent Chromium (CrO_3)

$$\frac{}{BN\ (0.4)} = \text{gm./100 ml. of total } CrO_3$$

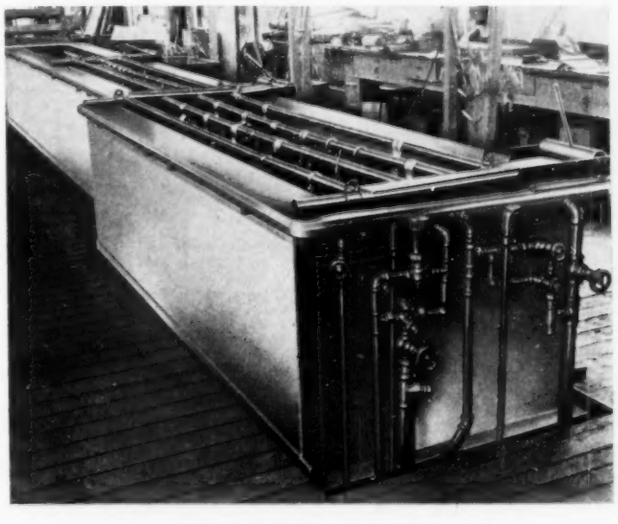
DISCUSSION OF ANALYTICAL METHOD

A spectographic analysis of a typical anodizing solution about one month old, run by courtesy of G. L. Cheney, Chief Chemist, of the Smith-Emery Company, is shown as follows: (Analysis on dry basis)

Chromium (Cr)	Major Constituent
Aluminum (Al)	5.0 %
Calcium (Ca)	0.5
Silicon (Si)	0.1
Magnesium (Mg)	0.1
Copper (Cu)	0.1
Sodium (Na)	0.01
Iron (Fe)	0.01
Manganese (Mn)	0.01
Strontium (Sr)	0.001

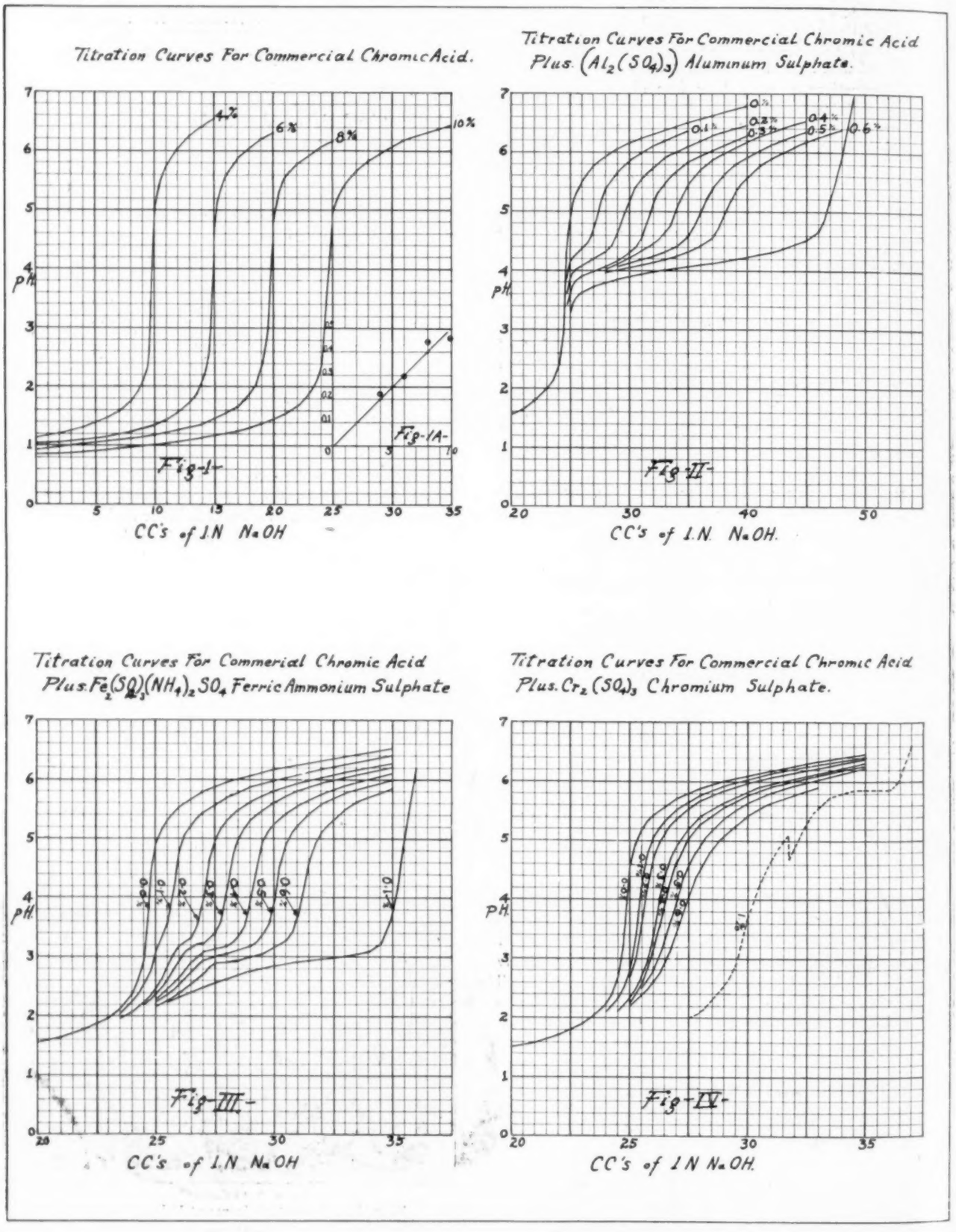
As can readily be seen from the analysis, the major contaminating element in the anodizing solution is aluminum. An impurity such as iron, which would interfere with our method of analysis in the alumina determination, is shown to exist in very small concentration (0.01%) as compared with 5% for aluminum. It is for this reason that we may, without appreciable error, report our results as aluminum. With the collaboration of Harold Schiller and E. R. Holman, courtesy of Turco Products, Inc., an investigation was made into the influence on the titration of chromic acid of the three most probable contaminants: Aluminum, iron, and trivalent chromium.

As a chromic acid solution is progressively neutralized, the pH rises according to the curves shown in Fig. 1. These curves represent a known concentration of 4%, 6%, 8% and 10% solutions of chromic acid, respectively. You will note at once that the space between the 8 and the 10% curves is exactly the same as that between the 6 and the 8 or the 4 and the 6% curves. This spacing is in direct proportion to



View of anodizing tank in use at Vultee Aircraft, Inc.

the amount of chromic acid present and obviously then we have a basis here for measuring the chromic acid content. As shown in Figs. 2, 3 and 4, this typical chromic acid curve is distorted by the presence of aluminum, iron and trivalent chromium, respectively, and this distortion takes place at a low pH, below pH 6. Now this distortion or deviation from the pure chromic acid curve appears to be a measure of the amount of contaminating metals present in the bath. By measuring the deviation at pH 4.8 on Fig. 2, it will be seen that the change in shape of the curve is proportional to



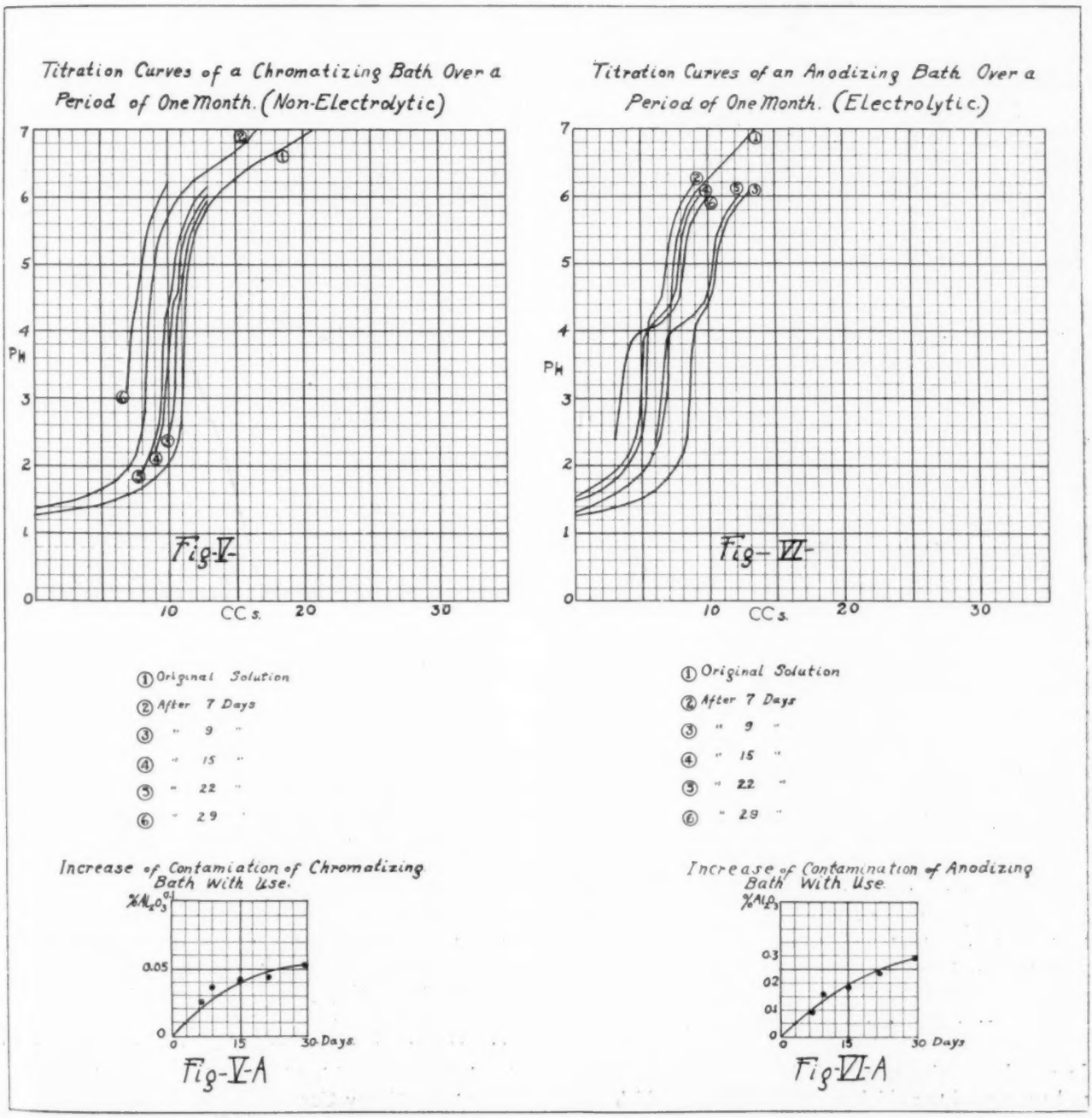
the amount of aluminum present. Therefore, from a given curve, the concentration of aluminum may be readily calculated.

Similarly, the presence of iron as an impurity in the solution affects the titration curve as shown in Fig. 3 and the presence of trivalent chromium as shown in Fig. 4. Both of these impurities, however, are known to be present in but very small quantities and for practical purposes their effect on the titration curve may be neglected.

The six curves shown on Fig. 6 represent the titration curves of the same bath on samples taken at six different periods in the life of this bath. By calculating the alumina content of each of these samples, according to the method which we propose and plotting these results against the age of the bath, we obtain in Fig. 6-A a picture of the rate of build-up of alumina through the use of the anodizing bath. The steady, progressive build-up of alumina in this bath as shown in Fig. 6-A is in complete accord with what one can reasonably expect from the anodic bath.

Figures 5 and 5-A represent a similar set of determinations made on the chromatizing solution. The chromatizing bath, as you probably know, is also a chromic acid solution operated at somewhat higher temperatures than for anodizing but without benefit of electric current. In the language of the electroplater, it is a still tank dip treatment. As might be expected, the chromatizing bath accumulates aluminum at a much slower rate than the anodizing bath.

For sake of comparison, you will note that in the period of 29 days, the anodizing bath accumulated 0.29% of alumina, whereas the chromatizing bath accumulated in the same length of time only 0.052% of alumina. Here again we note in Fig. 5-A that there is a steady, progressive increase in



alumina content and that the rate of increase is similar to that obtained in an anodizing bath on a much slower scale.

Summary

In summarizing the work illustrated in these graphs, we can say that we have developed a simple, rapid, reliable method for testing anodizing or chromatizing solutions, not only for their free chromic acid content, but also for the contaminating alumina content.

Notes on Plant Operation

There are several reasons why different companies operating with the chromic acid electrolyte get varying results. Among these reasons may be included: Variations in the ratio of anode to cathode areas from load to load; improper control of the free chromic acid content; using different insulation such as glass and wood on the tanks; and inconsistent distribution of clamps and inadequate or improper clamp design. As a result of all of these inconsistencies not covered by existing specifications, the Army specification for anodized coatings[6] has been revised, in that it now requires a good anodic[7] film without fixing the conditions of the operating process. Since the Army specification has been liberalized, the problem now becomes one of attaining the desired results by the most economical process.

Past experience has shown that it is more convenient to operate at a higher chromic acid concentration than 3% of chromic acid, substantiating the work of R. W. Buzzard[8] mentioned above.

A process for regeneration of the chromic acid, already proven in practice, consists of running the tank at a low voltage with lead plates as the anode, with anode-cathode ratio of 1:1. The process is somewhat analogous to the "porous cup" process used in chromium plating for the removal of trivalent chromium.

Glass Insulation

It is more economical in the chromic acid process to use glass insulation instead of wood. Transite has also been suggested as a substitute and has the advantage over glass in that you can cast your own forms. As to the chemical stability of transite, the only information is by hearsay that it is satisfactory.

Better current characteristics are obtained using glass insulation than when wood is used and very little sludge is formed. The installation is permanent and less chromic acid is reduced to the trivalent condition. The initial cost, about 25 cents per square foot, is not much higher than for wood. Rough wire glass plate is now being used successfully. Using the wood insulation, it has been noticed that when starting a new solution, the electrolyte seems erratic in its behavior, while with glass, it is more uniform and more reliable for the whole life of the electrolyte.

Ultimate Life of the Solution

In actual operation, the total chromates in the solution have been carried to as high as 40% as CrO_3, at which time the solution had to be thrown out because the chloride content limitation of 0.02%[5] was exceeded. If water free from chlorides had been used for making up and maintaining the bath, the life of the bath might have been extended even farther. It is believed that when the anode ratio to cathode area is kept at a high value, the solution is self-regenerating with regard to trivalent chromium. Stated in other words, as long as the anodizing bath is kept loaded to its full capacity, the trivalent chromium content is never present in any appreciable amount.

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PREVENTION OF NODULAR *and* POROUS NICKEL COATINGS

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Robert J. Green

THE formation of nodules at the cathode and porousness of electrodeposits are two of the phenomena of electroplating that have largely contributed to the rejection of plated work and the relatively high cost of refinishing.

Usually nodular deposits result from solid matter in suspension in the solution. These solids may be in a finely divided state and each tiny particle may deposit upon the cathode to act as a center for nodular growth.

Figure 1 is an illustration of what happens to a heavy gray nickel deposit when particles of solid matter are occluded in the deposit. The solid matter in this case happens to be particles of dirt, buffing compounds, dust, etc. This condition could easily have been prevented with good filtration.

In like manner, the tiny minute particles that contribute to the porosity of electrodeposited coatings can, in their turn, be prevented from attaching themselves to the deposit and thus bridging over to form a blister, or if they are very tiny, they are liable to bridge over in such a manner that they cannot readily be detected by visual inspection. The removal of these very minute particles requires a high standard of filtration.

DURING a visit to one of the large plants in the Middle West, devoted to the manufacture of water freezing equipment, the writer's attention was called to some very rough work, and his opinion sought as to its probable cause. This work was plated in a modern bright nickel bath, having a temperature of approximately 130° F., at a current density of about 35 amp./ft.^{2}

The rough work referred to was a part of a door hinge having a semi-elliptical shape. Several of these hinges were plated at one time. They were apparently racked in the proper manner, that is, they were suspended from the rack so as to preclude any possibility of dust or dirt from settling on the upper-most surface, and in addition, the cathode rod was constantly agitated as well as the solution, as it was under constant filtration. However, there were just as many nodules on the underside of the work as there were on the upper, and these factors eliminated any idea that the nodules might be due to the usual dust or dirt settling upon the surface of the liquid.

Running the tips of one's fingers over these rough deposits gave the impression of feeling very sharp objects. Examination with a powerful glass disclosed the fact that the nodules were, in some cases, bridged over with the deposited metal, and that they seemed to be of a slightly porous nature.

The plater, upon being questioned as to when this particular tank had last been thoroughly cleaned out, was assured that the entire solution had been removed from the tank, the tank thoroughly cleaned, anodes scrubbed and new bags placed on them, and in addition, the solution had been filtered through activated carbon and filter powder using canvas cloth as the filtering medium. This operation had been carried out the previous Saturday and inasmuch as they were operating on a 24-hour basis, it did not seem reasonable that the tank should be still plating rough on the following Monday, especially since it was under constant filtration during each working period since the time of its thorough cleaning.

The writer then voiced his opinion that the roughness was caused by very minute particles of filter aid and carbon that had passed through their filtering medium and back into the filtrate. A long glass tube was used to remove several samples of the solution from various portions of the tank. Some of the various samples were taken from the bottom of the tank and some from intermediate portions of the solution between the bottom and the top and each particular sample contained a great many particles of what appeared to be rather heavy sediment. Some of these particles were so fine that they gave this bright nickel solution a rather cloudy appearance.

Close examination of these "particles" under the microscope revealed their similarity to the filter aid used for their previous filtration. A comparison of the apertures in their particular filtering medium with the grain size of the filter aid, proved that it was possible for the finely ground particles of filter powders to pass through and back into the filtrate.

FORTUNATELY, one of the modern high speed filter units was available. This filtering machine was fitted with a set of filtering sheets designed for the purpose of removing the very minute particles of foreign substances from plating solutions. It was set in operation on this plating bath and almost immediately the rate of filtering began to decrease indicting the plating bath contained excessive amounts of sludge.

Yet, as stated above, the several samples of the cross section of the liquid did not indicate excessive sludges. However, the reason the filtrate usually decreases in volume is because the filtering media become clogged.

Subsequent examination of the filtering sheets showed a definite deposit of what appeared to be filter powder and carbon on each sheet. These particular filter powders were of such an extremely fine nature that they partially penetrated the filtering sheets and caused the decrease in the rate of solution being filtered. But such was the texture of these filtering sheets that none of the very finely divided powders passed through the filtrate and in a very few hours, this bright nickel solution was entirely clean and the rough deposits had disappeared.

In addition, tests in the salt spray indicated that the extreme porousness evident before had practically disappeared. In fact, it was thought that the only evidence of porosity was due to the natural porousness of the deposited electrocoating. Thus, it is evident that rough work is not always due to the sludge which naturally accumulates in the plating bath, but it may and can be due to the filter aids that have passed through coarse filtering media.

Fig. 1. Shows structure of nickel deposit containing inclusions.

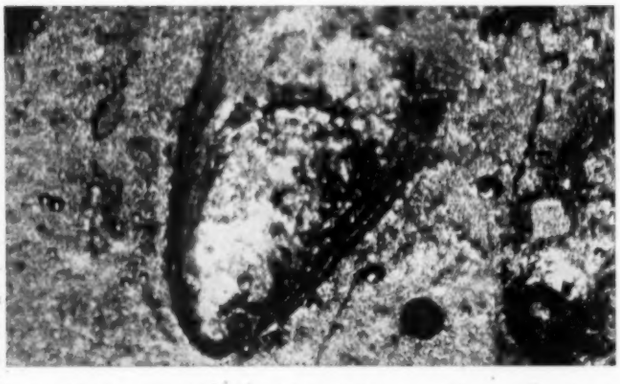

Fig. 2. Nebula type pitting in nickel solution containing organic decomposition products.

HENCE, if one must use filter aids, one should pay attention to the grain size of the filter aids in comparison with the apertures in the filtering medium, unless of course, one were using a type of filtering sheet that is not subject to the use of outside filter aids. If one is not particularly alert in selecting the proper filtering media for the daily filtration of his particular plating solutions, it will then be possible for the finely devided sludges that accumulate under ordinary plating conditions as well as filter powders, etc., to pass through into the filtrate. It then stands to reason that some of these particles will be carried across to the cathode and then be deposited with the electrocoating.

It is all very well to say that as these sludges and filter aids continually pass through the apertures of the filtering medium, they will in the course of time, tend to form themselves into a "cake" or "bed" and will then stop going through. But, in the meantime, while this "cake building" is going on, what is happening to the plated work? It needs no stretch of the imagination to perceive that impurities are depositing at the cathode and it only takes a few pieces of porous work to fail in the porosity test to reject a whole shipment.

Figure 2 graphically illustrates nebular type pitting encountered in bright nickel plating. These pits are from the presence of insoluble matter. Generally speaking, the particles are so tiny that they are usually measured in terms of microns. Yet, regardless of how tiny they may be, they can be removed by the use of filter sheets especially designed for that purpose.

EXCESSIVE porousness in work that has been plated in a bright nickel solution is a particularly bad situation to encounter, especially when plating to specifications. Though the actual thickness of the deposited coating will be, in all probability, up to standard, nevertheless a test for porosity either with the salt spray or other device will very quickly show up the porosity of the plated coating.

The logical answer to these problems is, of course, "filtration", but not just ordinary filtration. One should give special consideration as to all the factors involved, the nature, the amount and the origin of the nodular deposits with particular attention as to whether the nodules are from finely ground filter powders, spongy anodes, dust and dirt, or the natural accumulation of sludges.

Special consideration should be given to the "termites" of the metal field, the little "bugs" that cause porous coatings. Whenever rough plating is evident, one can rest assured that there are other tinier particles that have been occluded in the plate and bridged over. These latter particles are, of course, so minute that they are not readily visible to the naked eye and cannot, therefore, be readily detected, except with the use of a porosity testing apparatus.

Just as these problems involve special consideration, so should the selection of the proper filtering medium and filtering technique that will remove the contributing factors to nodular growth—that will prevent the "termites" from causing porous coatings.

The axiom, "An ounce of prevention is worth a pound of cure", is certainly applicable to modern production plating.

SURFACE ACTIVE MATERIALS *IN* ACID PICKLING SOLUTIONS

BY DERICK S. HARTSHORN, JR.

Technical Director,
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New Haven, Conn.

D. S. Hartshorn, Jr.

Surface active materials are now available for use in acid pickling solutions. The author discusses specific advantages gained by the use of these materials in sulphuric and hydrochloric acid pickles. These advantages include more uniform pickling, savings in acid, less attack on the base steel, reduced acid spray, and elimination of water-breaks in the acid pickle. Specific case histories are discussed, and specific applications are considered. These include stripping heavy chromium deposits from steel, electrolytic pickling, and pickling previous to plating. —Ed.

Introduction

PICKLING solutions or acid dipping solutions composed of either sulphuric or muriatic acid and water have relatively high surface tensions of the order of 60-75 dynes per centimeter, not greatly different from pure water whose surface tension under normal conditions is 72-3 dynes per centimeter. The high surface tension of pickling solutions is the reason for their poor wetting power and thus if even traces of oil are on the surface of the steel being pickled, pickling action is inhibited or retarded at that point until the hydrogen being evolved adjacent to the spot, together with an undermining action of the acid taking place on the steel, result in displacement of the oil to allow attack of the acid on the oxide or scale. As a result of this condition, pickling of even slightly oily work may result in unevenly pickled or mottled work.

Only recently have surface active materials been available which are stable in strong acid solutions and which have other properties required in acid pickling. The wetting agent must not leave an oily film on the work, it must not form too stable foam, it must not hydrolyze and it must not be reduced by the hydrogen being evolved during pickling. Some of the specific advantages of the use of proper surface active materials in pickling solutions will be described.

More Uniform Pickling

Very seldom is the work being pickled completely devoid of oil and therefore, as mentioned above, the cleaner portions of the work are pickled first and may be overpickled before the oil film is undermined and the acid can act on the surface protected by the oil. A lower surface tension solution will displace this oil film much more readily than the usual high surface tension pickling solution. One commercial material,* for example, lowers the surface tension of a 1:1 hydrochloric acid solution from 69 dynes per centimeter to 31 dynes per centimeter when used in a concentration of 1 pound to 50 gallons of pickling solution.

Non-uniform pickling is particularly bad when the work is to be bright plated or the plate is to be buffed. The deposit naturally reproduces the structure of the base steel and thus the deposit will be alternatively bright and dull if the base metal is that way.

Uniform pickling is also very important for work which must have high fatigue life such as is the case with much of the steel being pickled for armament. Severe local attack on the steel may lead to a marked reduction in fatigue life and even in reduced ultimate tensile strength of the object being pickled.

An interesting case of the advantage of using low surface tension pickling solutions occurred in the pickling of large rusted wire reels. No alkaline cleaning facilities were available for cleaning the large reels which were coated rather non-uniformly with rust, wax and grease. When these reels were immersed in a strong hydrochloric acid pickle, they were poorly pickled in a full hour. However, when a surface active material was added to the pickling solution, an almost immediate displacement of the grease and wax occurred, and complete pickling was accomplished in from 5 to 10 minutes.

Another plant was having trouble with the pickling of large tubes which had narrow crevices containing oil and this oil could not be completely removed by alkaline cleaning. Some oil was evolved during pickling and this was carried into the nickel plating solution resulting in peeled plate at those spots. The use of a surface tension depressant in the acid dip resulted in removal of the oil

* Name furnished on request.

liberated during pickling, thus obviating the peeling trouble.

The use of an acid addition agent in a full automatic zinc plating machine enabled the plating of certain heavily rusted parts that were not being completely pickled with the regular acid solution. The heavily rusted parts were being pickled separately by hand thus increasing the cost of plating. When a surface active material was added to the hydrochloric acid pickle in the full automatic machine, it was found that the parts were completely pickled. The addition of the surface active material to the acid gave the acid greater penetrating action under the heavy scale thus resulting in faster pickling.

Saving Acid

The scarcity of all mineral acids should make the adoption of acid saving devices imperative. The average plating shop is rather wasteful of acids because of their relative cheapness. The use of addition agents in acid solutions results in acid savings because of two factors—inhibiting action and lower dragout. As discussed in a previous article[1], surface active materials are polar substances and possess both a polar or water soluble portion of the molecule as well as a non-polar or oil soluble portion of the molecule. Thus when a surface active material is added to a pickling solution, the polar portion of the molecule tends to be attracted to the metal surface and the non-polar portion projects into the solution. This orientation of the wetting agents results in a so-called inhibiting action of the acid on the steel. One wetting agent or acid addition agent when added in quantity of 1 lb. to 50 gallons of pickling solution, results in 75% inhibiting action. This means that waste of acid by attack on clean steel is reduced 75% and also that the metal surface is that much smoother. Complete inhibiting action is not desired in cases where black oxide or scale (magnetic oxide) is to be removed. The reason for this is that acid does not dissolve magnetic oxide or hammer scale directly. This oxide of iron, common on heat treated work, is almost inert to hot sulphuric and cold muriatic acids. During pickling, any surface ferric oxide is readily dissolved and underneath the black scale there is a thin film of ferrous oxide which is readily dissolved by acid, providing the acid can have access to it. The lower surface tension of the acid solution with a surface active material, therefore, enables better penetration of the acid into the narrow crevices under the black scale thus resulting in faster pickling. The removal of the black scale is also facilitated by an undermining action on the base iron itself, and, of course, this undermining could not take place if the wetting agent completely inhibited action of the acid on steel.

The use of a surface active material in acid solutions results in savings in acid due to less drag-out. This occurs not from a decrease in viscosity of the solution, but rather from a thinner film remaining on the work and racks. The size of drops of acid solution on the work or racks is much greater with acid of high surface tension than with low. In fact one method of determining surface tension, called the "stalagmometer method" involves counting the number of drops of acid falling from an orifice from a standard volume of solution.

More Pleasant Pickling

Pickling with strong hydrochloric acid (muriatic acid) solutions is particularly unpleasant unless good exhaust ventilation is provided. This is due to the volatile nature of hydrochloric acid (commercial hydrochloric acid is approximately 35% solution of the gas hydrogen chloride in water—Ed.). Acid fumes are particularly harmful to the teeth of workers since even small amounts in the mouth will cause increased attack or dissolving of tooth enamel. Enamel is essentially calcium phosphate which is solubilized by being changed to acid phosphate in the presence of active mineral acid such as hydrochloric or sulphuric acids. Workers in acid fumes should periodically rinse their mouths with a mild alkaline solution, such as a sodium bicarbonate solution.

Surface active addition agents in acid pickling solutions make pickling more pleasant because they markedly reduce the amount of hydrogen evolved. The breaking of hydrogen bubbles on the surface of the acid solution causes an acid spray. The addition agents tend to cause a foam to form on the surface of the acid and this foam prevents spray formation. The degree of foaming can be controlled by the choice of surface active material and this subject was discussed in detail in a previous article[2].

The reduction in fumes not only improves the health of the workers but reduces corrosive attack on plating equipment, exhausts, etc. Acid spray falling on finished work particularly in summer, may cause rapid staining or spotting. In a moderate draft, the spray from acid tanks travels from 50 to 100 feet.

Stripping Heavy Chromium

Faulty hard or heavy chromium on steel dies is usually stripped in strong hydrochloric acid solutions. One surface active material has proved to be very useful when added to the hydrochloric acid chrome strip. It enables stripping of heavy chromium without marring the surface of the steel die. This is important not only to obviate repolishing of the die but also to prevent dimensional changes due to the dissolving action of the acid on the steel die.

Acid Dipping Previous to Plating

The most indicative spot in the plating sequence to see whether the work is being properly cleaned is the acid dip used after cleaning. If no water-breaks appear on the work after the acid dip or pickle, then it is fairly certain that the work is being cleaned of organic dirt, but this is no indication that the work is "metallurgically clean" to quote one of the leaders in the cleaning field. Metallurgically clean means the removal of both organic dirt and inorganic dirt such as carbon, metallics, silica and drawing compound fillers.

1. Metal Finishing **39**, 121 (1941).

2. Loc. cit.

Work may have no water-break after alkaline cleaning and still a water-break may appear after acid dipping. This may result from the presence of poor rinsing soaps in the alkaline cleaner remaining on the work after rinsing, and the film of soap is converted to free fatty acid or "grease" when the work enters the acid solution. This can also happen when the cleaner contains good rinsing soaps but poor or incomplete rinsing is performed. Unfortunately, rinsing is frequently done both inefficiently and incompletely. An alkaline cleaner may not have any soap in it as supplied by the vendor but soap can form in the cleaner by saponification of stearic acid and tallow in drawing compounds and buffing compositions.

It is obviously difficult, therefore, to keep work completely clean of adsorbed soap films. In some cases, these films may be so thin that their effects show up in poorer adhesion, dullness of plate or pitting rather than out and out peeling. Of course, there will be cases where work enters the acid dip, previous to plating, with a film of organic dirt because of poor cleaning. For both cases mentioned, the presence of a proper addition agent in the pickle will assist in removing the organic dirt and allow complete pickling. The pickle will act as a cleaner as well as pickle. Ordinary acid dips without a surface active material would be almost ineffective in removing these films and the pickling would be incomplete and spotty.

The inhibiting action mentioned previously is important for pickling work previous to plating because it prevents the formation of carbon smut which results from over-pickling of the surface of the steel. This carbon smut usually does not cause the plate to peel but experiments have shown that it does cause a reduction in adhesion, which factor is important when the plated work must be subsequently deformed, and the smut affects the brightness of the plate, the ease of buffing, and the porosity of the deposit.

Electropickling

Surface active materials are being used in electrolytic pickling and scale removal processes. The lower surface tension of the solution results in faster scale removal because of better penetration of the acid under the scale. In addition, the slight foam reduces acid spray. In the Bullard-Dunn Process where tin is deposited during the pickling, the tin coating is considerably brighter with a certain wetting agent.

Not All Wetting Agents Satisfactory

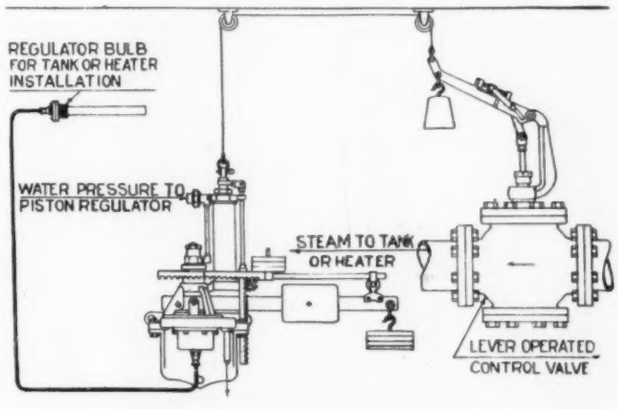
It must be understood that all wetting agents are not satisfactory for use in pickling solutions. Some are not stable and hydrolyze to tarry, messy substances that will spoil the pickling solution and will contaminate the work being pickled. Other wetting agents particularly the alkyl sulphates give too stable foam and are too strongly adsorbed for good rinsing. However, excellent materials have been developed for pickling solutions and the advice of the supplier should be sought.

Temperature Control in Metal Working Plants

Here is a question that is commonly asked by operators of metal working plants:—"How can we control valves, dampers, and other regulating devices automatically through small change in temperatures?"

The accompanying sketch shows an excellent way in which to do it. The regulator bulb at the left is placed in the tank, heater, or gas passage which is to be regulated. It transmits a slight force to the intermediate regulating device shown in the center. Then by means of water pressure from the city main or elsewhere this central device, which is "touched off" by the slight pressure change, gives the necessary force through the cable to operate a large valve, damper, or gate without any human aid whatever. It works backwards as well as forwards, the counterweight doing the closing.

Take for example the large lever operated control valve shown in this sketch. Attempts to handle steam valves as large as 3 inches by temperature regulation alone, without the aid of water or air pressure, usually result unsatisfactorily. An intermediate power device, such as employed here, is generally advisable. It may be necessary to develop a special opening and closing lever like the one used on this valve, but it usually *can be done*. The arrangement as sketched here operates very well. It is a dependable method which assures automatic temperature regulation within close limits.



NEW EQUIPMENT AND SUPPLIES

NEW PROCESSES, MATERIALS AND EQUIPMENT FOR THE METAL INDUSTRY

Control for Pickling Tanks

The Brown Instrument Company, Philadelphia, Pa. has developed a Temperature Control System for Pickling Tanks which has been designed not only to overcome the difficulties arising from corrosive conditions in the pickling room but to lend itself to ease of manipulation as well as accuracy in operation.

The greater uniformity of pickling which is an inherent characteristic of controlled picklers is only one of the many advantages observed in actual practice after the system has been installed. Because temperatures may be duplicated for long periods of time, the actual pickling which occurs may be held at an optimum level.

Other advantages which are realized after the system has been put into operation are as follows:

1. Shortening of pickling time because optimum pickling takes place at one certain temperature for each acid.
2. Saving materially on steam cost by avoiding high temperature following the heating up and during low load periods.
3. Saving of acid which is lost on high temperature evaporation.
4. Reduction of injuries to men and machinery.
5. Reduction of discomfort to working personnel.

Bulletin No. 23-56 issued by the manufacturer contains a description of this new system. Included are descriptions of the principle of operation and models available, a schematic layout of the Brown Temperature Control System for Pickling Tanks and specification sheet containing a picture of the Brown Indicating Control Potentiometer.

Automatic Polishing Machine

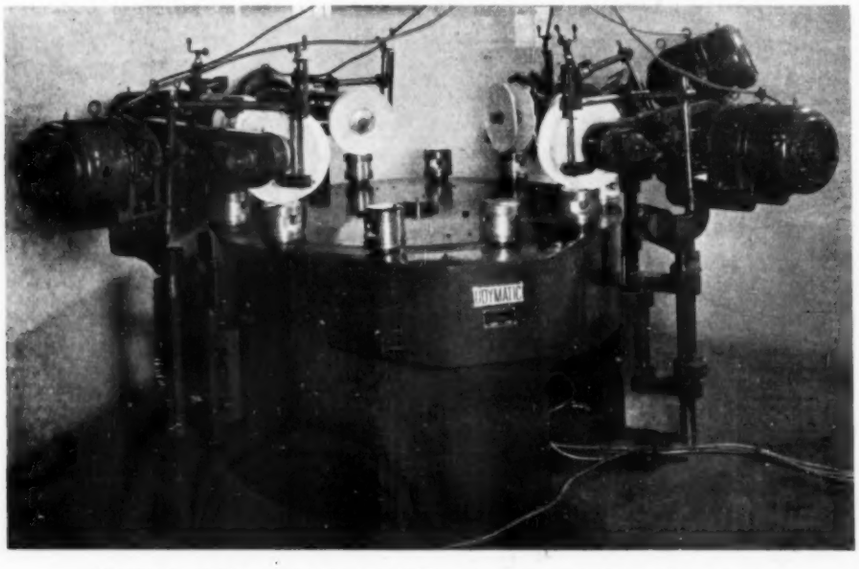
The Udylite Corporation, Detroit, Michigan, manufacturers of electroplating and polishing equipment, announce the development of an automatic polishing machine for buffing aluminum aircraft engine pistons. This machine is said to have reduced production time 97½% in comparison with the old-fashioned method of buffing pistons by hand on a manually operated buffing lathe.

The machine shown in the illustration buffs the sides and top in fifteen (15) seconds as against ten (10) minutes with the hand operation.

The machine consists of an index table which indexes automatically. There are twelve chucks to hold the pistons, which rotate during the buffing operation. The chucks are stationary during the indexing period and during the loading and unloading. Six buffing pedestals are arranged around the machine to accommodate the buffing wheels which are driven through a "V" belt drive. The buffing heads have the exclusive Udylite feature of "full-float." Buffing pressure is adjustable by means of a tension spring so that the buff rides over the work to provide uniform buffing pressure at all points. The wheels may be adjusted to any angle desired.

One of the principal features claimed for this machinery by the manufacturer is its versatility. The machine may be adapted to a variety of circular parts by merely changing work holding chucks or fixtures. Any buffing adjustment to contact surfaces requires but a few minutes.

With such machines, one operator is required to load and unload.



Automatic polishing machine for buffing aluminum aircraft engine pistons.

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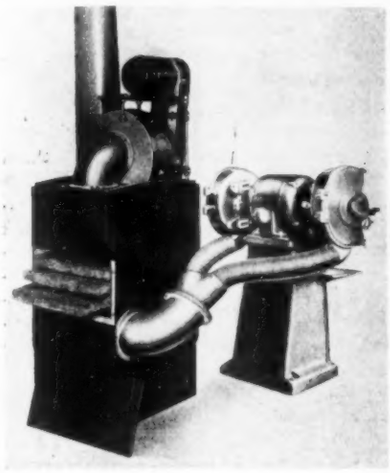
Exhauster and Filter for Polishing Lathes

The Hisey-Wolf Machine Co., Cincinnati, Ohio, have developed a combination exhauster and filter for use on pedestal lathe polishing and buffing machines.

The dust-laden exhaust air enters a cyclone collector which removes the coarser particles and then passes through impingement type filters which are claimed to remove the fine dust, thus enabling the re-circulation of air in the room. The motor is externally mounted to assure cool and clean operation.



Exhauster and filter for polishing lathes.

A handy clean-out is provided for the heavy particles and the filters are readily removable for cleaning by shaking. The equipment is available in four sizes which are capable of handling air volume from 630 to 1336 c.f.m.

New Equipment for Processing Shell Casings

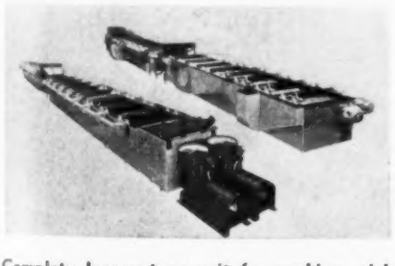
The Hanson-Van Winkle-Munning Co., Matawan, N. J., has developed new Mercil type of equipment for washing, pickling and rinsing 20 mm. shell casings after annealing. Installations will be made shortly by two well-known concerns.

One of these installations will have a Mercil type rotary cleaning unit with a loading compartment. This particular unit is motor driven. An exhaust hood is included for the cleaner tank, and steel cylinders are also included.

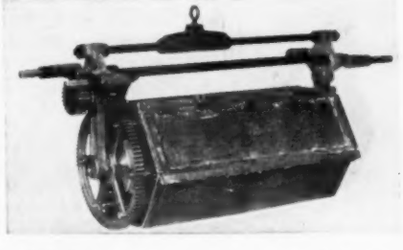
The pickling unit consists of a double station hot sulphuric pickling tank, a spray rinse compartment, a cold rinse compartment and a final hot rinse compartment. The pickling compartment is lead lined with lead coils to withstand the hot sulphuric acid used. The warm rinse and the spray rinse compartments are also lead lined, a lead coil being included for the warm rinse tank. The unloading hopper on the warm rinse tank is made of Monel metal with ½" perforations and suitable exhaust hoods are included for the hot sulphuric acid pickling compartment. Monel cylinders, 16" in diameter x 30" long with ½" perforations, gears and hangers made of bronze, ¼" Monel heads and ⅛" body stock are included. Cylinders of this size hold about 600 to 700 shells.

It is noteworthy that shell casings must be drawn, annealed and pickled at least six times.

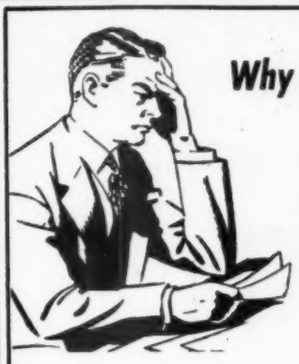
In another installation the regular soak cleaner tank is being followed by a cold



Complete hopper-type unit for washing, pickling and rinsing shell casings.



Cylinder for processing steel shells.



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DURABLE—reduces the need for recoating.

CONVENIENT—any part can be patched without recoating the entire rack.

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rinse tank which is in turn followed by a quenching tank. One steel cylinder is used, 20" x 30" size with ½" perforations, complete with handers and gears.

Another operation in this treatment cycle is pickling in a tank equipped with Monel exhaust duct, the tank being lead lined and having a lead coil. This operation is followed by successive rinses in a lead lined tank, a plain rinse tank and a warm rinse tank. Two 16" x 30" Monel cylinders are used, and on this particular installation each tank operates individually.

Most of this class of work is covered by an A-1-a priority which assures that material as needed can be secured, and shipments can be made in five to six weeks from the receipt of orders.

New Metal Replaces Aluminum Foil

The Display and Container Division of the Reynolds Metals Company, New York, have announced the development of a new composition metal to be substituted for aluminum foil. The packages made from the new composition metal are said to be finding ready acceptance in the food field. The foil presents opportunities for brilliant display. Gold and silver backgrounds for embossed and printed labels on packages predominate in early deliveries of the new composition metal.

The containers are made of a highly calendered paper board with foil on the outside and with a clear plastic over a sized clay coating on the inside. This construction is said to protect food because the construction shuts out all light and in addition moisture loss or gain are obviated.

Cellophane Packages for Small Parts

Leece-Neville Co., 5363 Hamilton St., Cleveland, Ohio, have available cellophane packages, as illustrated, to contain various

Metal parts wrapped in cellophane packages.

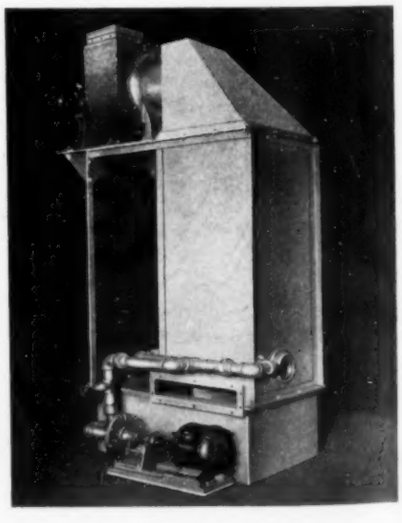
manufactured parts. These packages are of special interest at the moment because of difficulty in obtaining boxes to contain small parts.

The use of these bags is claimed to entail the following advantages: (1) quick identification because the bags are transparent and facilities are available for writing on the face of the bag; (2) rust protection is afforded by the relative moisture-proofness of the package; (3) the relative compactness of the package, and (4) the products are tamper-proof because the bags can be sealed.

Dust Collector

The new Hydro-Whirl dust collector developed by the Industrial Sheet Metal Works is claimed to mark a notable advance in industry, since it removes all of the hazards that have attended the processing of magnesium and its alloys. Relieved of the fear of handling magnesium, manufacturers can now feel more secure in using this material to a greater degree than they ever have before. Every metal today plays an important part in the Defense Program and none should present any restrictions to use.

The dust created by buffing, polishing, and grinding of parts is effectively trapped by the Hydro-Whirl, the functional part of



Hydro-Whirl dust collector.

this new dust collector, and is brought down into a tank. Thus, practically all the insidious dust is removed from the area of operations and is transformed into an inactive element in the form of a sludge which is later either burned or buried in the ground.

Many units are already in use by leading parts manufacturers who are now utilizing magnesium in larger volume. The company reports that the performance of these units has attracted the attention of a number of renowned chemical engineers whose chief interest is safety in industry. Insurance companies and fire protective associations, too, have recognized the safety factors apparent in this new development.

The Hydro-Whirl is an entirely new principle in wet dust collecting and is effective on all types of metal dust, not only magnesium but aluminum, iron, steel, and others as well. The working mechanism consists of a rotating shaft on which are centered a series of discs. The controlled rotating speed of the shaft in a horizontal plane throws a rain of water into the baffled section of the unit at which point the dust is whirled out of the air stream. Scientific calculations have attained a proper balance between the velocities of air and water. This balance insures thoroughly cleaned air which may be returned to the building.

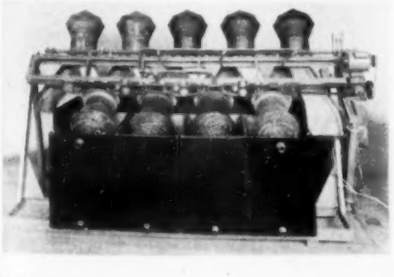
For further information, write to the Industrial Sheet Metal Works, E. Forest at Antoine, Detroit, Mich.

Full Automatic Machine for Cleaning & Plating Small Parts

The development of a full automatic barrel cleaning and plating machine for handling small parts in bulk has been announced by the Udylite Corporation, Detroit, Michigan, manufacturers of plating and polishing machinery.

Several of these machines are now in operation and have proved to be extremely satisfactory. They are particularly adaptable to the processing of parts for ordnance. Several such machines are being used to automatically zinc plate machine gun clips in continuous production; machines are being used to handle 20 mm. brass cartridge shell cases as the latter are subjected to the various cleaning, rinsing and pickling operations. Other machines are being employed to zinc and cadmium plate aircraft engine parts continuously.

The manufacturer states that this new machine offers radical improvements over existing machinery and makes possible the complete finishing of small parts with absolute minimum of labor expense. The machine is completely automatic in that the parts are progressively subjected to the various cleaning, rinsing, pickling, plating and drying operations without manual handling.



Full automatic machine for cleaning and plating small parts.

The specific advantages claimed by the manufacturer are as follows:

Savings in Labor

The automatic transfer greatly reduces the man hours necessary to process small batches of work through the various solutions. The only manual labor required is at either end of the machine. This eliminates 8 to 10 hand operations.

Savings in Material

The operators using this machine do not need rubber gloves, boots or aprons and do not come in contact with the material after it is loaded until it is discharged clean and dry. No baskets are needed to transfer the work from one solution to another. The tanks in the plating barrels have sufficient anode and solution capacity to maintain the correct metal content without addition of metal in the form of salts.

Savings in Electric Power

The entire machine is driven by one motor. This eliminates the need for individual motor drives and the accessories such as starters, conduit, etc.

Savings in Installation

The machine is shipped complete, ready to connect to the water, air and electric supply and will greatly reduce the amount of labor and material needed in a manually operated layout.

Health Hazard Reduced

The removal of the operator from over the tanks will increase his productive capacity as he is not endangered by fumes or cyanide burns. Also, there is no chance of his transferring work directly from the cyanide to the acid tank which would generate deadly cyanic acid gas.

Production Control

The amount of work processed in a day

These Protective Coatings HELP TO SOLVE Two Of Your Most Important CURRENT PROBLEMS

Miccro Supreme
STOP-OFF LACQUERS
•
MICCROLITE
Developed and Manufactured by Experienced Platers

Today, you must keep production rolling without interruption . . . . and YOU MUST CONSERVE ON THE USE OF PLATING METALS. Miccro-Supreme Stop-Off Lacquers and Miccrolite can aid you on both counts.

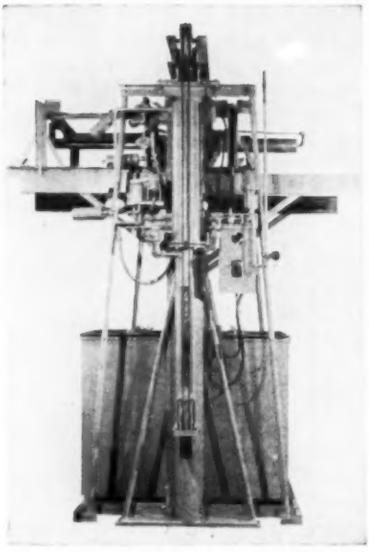
In securing effective protection for all types of plating racks, or for masking parts for hard chromium plating, there are no materials which can be applied easier or more quickly. They always stand up through complete cycles of plating operations . . . . in all acids and cleaning and plating solutions. As they are applied right in your own plant—and at negligible cost—you have none of the delays caused by outside sources of supply.

These materials provide *complete* protection of every portion of the surfaces they cover. For that reason, unless plating racks are damaged in process, there is no possibility of a surface becoming exposed and of plating metals "piling up" at that point. Waste of valuable plating metals is reduced considerably, and priorities problems can prove much less troublesome.

IF YOU ARE NOT FULLY ACQUAINTED WITH THE ADVANTAGES OF USING "MICCRO PRODUCTS" TO AID IN YOUR DEFENSE PRODUCTION, WRITE FOR INFORMATION—TODAY.

MICHIGAN CHROME & CHEMICAL CO.
6348 EAST JEFFERSON • DETROIT, MICHIGAN

Crown Pick-up Unit



...MACHINE...

A UNIT TYPE TRANSFER CAPABLE OF HANDLING SEVERAL TANKS AT ONE TIME.

●

...USE...

FOR A SERIES OF OPERATIONS WHERE THE WORK MUST PASS THROUGH SEVERAL TANKS, AS THE CLEANING AND RINSING OPERATIONS, FOR A SEMI-AUTOMATIC PLATING TANK.

CROWN RHEOSTAT & SUPPLY CO.
1910 MAYPOLE AVENUE :-: :-: CHICAGO, ILLINOIS

is not governed by the operator and each batch of parts is given the exact treatment designated by the time clock on the machine.

Process Control

The machine is timed by an electric clock and cannot be slowed down or speeded up by an unauthorized person.

Low Maintenance

The simple design eliminates many expensive moving parts and permits easy access to the barrels for removal or repair.

Modern Design

The Udylite Automatic barrel is designed to process bulk parts in large or small quantities and give the plating room a machine comparable to the automatic screw machines, punch presses, etc., long accepted as commonplace in other production departments.

The Company states that full information describing this machine will be furnished to interested manufacturers.

Induction Heater

Induction Heating Corp., 791 Broadway, New York, N. Y., have developed a thermonic generator for various heating purposes.

The generator produces high frequency current which may have a frequency of 500,000 cycles per second, which is transmitted through a coil that is made from one or more turns of copper tubing, and which is identified as the "work" or "heating" coil. This coil is shaped to closely follow, without touching, the contour of the part to be heated. Transmitting this current through the coil, sets up a highly magnetic field within the area enclosed by and surrounding the coil. Both ferrous and non-ferrous metals are readily heated.

High operating economy is claimed and maintenance and replacement costs are stated to be very low.

The thermonic power tube and rectifier tubes are designed with an overload factor of 50%.

Wide fields of application are claimed for the equipment. Some of these include surface hardening in which the hardening can

10 kw. Thermonic generator

be localized to exactly where it is wanted and without scale, decarburization or distortion. Heating for brazing, annealing, forging and heat treatment is claimed to be cleanly and accurately done. Acting directly upon the metal itself, temperatures up to 5000° F. are said to be obtained with a minimum of metal oxidation.

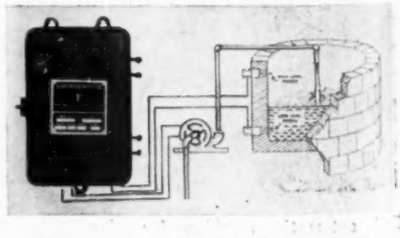
The photograph illustrates the company's 10 kw. vertical model thermonic generator.

Electronic Level Controls

Photoswitch Inc., 21 Chestnut St., Cambridge, Mass., have developed liquid level controls which provide on and off valve or pump control for any kind of liquid. Controls may be used for water, milk, nitrates, alcohols, refrigerants, plating solutions, solvents, etc.

Complete equipment is available for single level indication and control, on and off pump-up and pump-down control at two levels, boiler feedwater control and low level safeguards. Probe fittings have been designed for high and low pressure and temperature requirements, as well as for sanitary installation.

Photoswitch probes or electrodes are attached to the tank at levels representing the low point where pumping starts and the high level where pumping stops. These probes are wired to the level controls. When the liquid level falls below the



Shows use of electronic level control

lower probe, the level control starts the pump in operation and the tank fills. When the level rises to the upper probe, the fluid itself acts as a conductor of the small amount of current required for the operation of level control which stops the pump. Even when used with nonconductive fluids, the probe circuit carries only milliamperes of current and low voltage.

Since these controls do not involve mechanical float or pressure switches, they are claimed to be easily installed and maintenance is free.

The controls are described in a 4-page bulletin.

Lightweight Sweatband

A new lightweight absorbent sweatband, made of synthetic sponge, is announced by the American Optical Co., Southbridge, Mass. The sponge is 7½" long, covers a generous width of brow. The sweatband can be sterilized, used again and again. It keeps sweat out of eyes and off goggles, thereby keeping vision clear so that foundrymen, welders, and other workers on hot jobs won't get blindly into harm's way.

In connection with the announcement, the optical concern points out that time studies in a large foundry showed chippers and grinders spent 42 minutes per man per day mopping goggles and foreheads, a needless loss of time and definite proof that workers need the comfort and protection given by a reliable, truly absorbent sweatband. Also, as comfort is increased by wearing a sweatband, fatigue lessens and a man can do better, faster work.

Grinding Wheel Dresser

The Ideal Commutator Dresser Co., 1941 Park Avenue, Sycamore, Illinois, announces a new abrasive wheel type grinding wheel dresser that is said to give a cutting and truing effect almost equal to that of a diamond.

The cutting wheel is held in a protective metal housing which deflects the grindings away from the operator. A large handle makes it convenient to hold and use. The

Grinding wheel dresser in use

cutting wheel is replaceable when necessary.

Besides general cleaning and truing of a grinding wheel, other uses include the truing of cut-up and uneven sides, dressing out deep grooves and out-of-roundness, restoring out of balance wheels into true rotating ones. It can also be used to shape wheels into different forms when form grinding is desired.

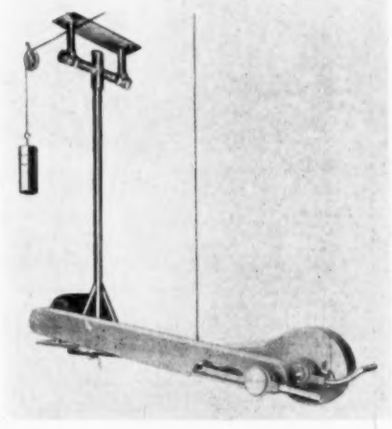
Overall length 13¾". Weight 3⅛ lbs.

Swing Frame Grinding and Polishing Machine

Jefferson Machine Tool Co., 4th, Cutter and Sweeney Sts., Cincinnati, Ohio, have developed their "No. 101 Swing Frame Grinding and Polishing Machine," which is designed for wheels up to 14" in diameter.

The machine is full universal and can be swung forward and backward, up and down, right and left, and at any degree of angle or twist at the spindle head. The machine is easily bolted to the ceiling and no aligning or counter shafting is required.

The swing lathe is recommended for grinding and cleaning of rough castings of any kind, shape or size prior to enameling, plating or other finishing operations. It can also be utilized for standard type grinding and polishing wheels for grinding or polishing sheets, tubing, bars, shapes, etc.,



Swing frame grinding and polishing machine

Metso Cleaners Suspend Dirt

USERS of Metso Cleaners know they choose wisely, for they depend on Metso to remove dirt and also to keep it from reaffixing itself to the clean work.

Metso Cleaners suspend grease, oil and dirt, and prevent them from redepositing on the metal. This action is a special function of silica (SiO_2) content of Metso. Electroplaters particularly welcome the chemically clean surface which Metso gives.

May we tell you more about the role of silica in Metso Cleaners and how it aids you in cleaning metals more efficiently?

PHILADELPHIA QUARTZ COMPANY

EST. 1831

Gen'l Offices: 125 S. Third St., Phila., Pa. Chicago Sales Office: 205 W. Wacker Dr.

Sodium Metasilicate U. S. Pat. 1898707. Sodium Sesquisilicate U. S. Pat. 1948730, U. S. Pat. 2145749

METSO CLEANERS

METSO

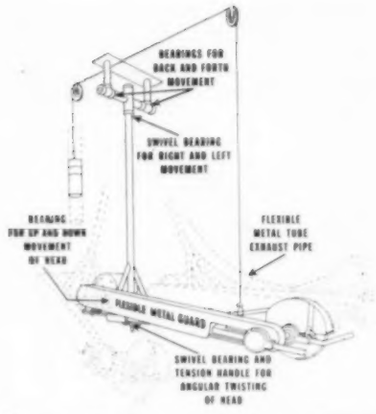

BEARINGS FOR BACK AND FORTH MOVEMENT
SWIVEL BEARING FOR RIGHT AND LEFT MOVEMENT
BEARING FOR UP AND DOWN MOVEMENT OF HEAD
FLEXIBLE METAL TUBE EXHAUST PIPE
FLEXIBLE METAL GUARD
SWIVEL BEARING AND TENSION HANDLE FOR ANGULAR TWISTING OF HEAD

Diagram showing construction and operation of swing frame grinder and polisher

too large or unwieldy for the usual standard floor lathes.

It is said to do the work of two men, thus releasing the smaller grinding or polishing machines for other purposes. Scratch wheel brushes can also be used for cleaning castings.

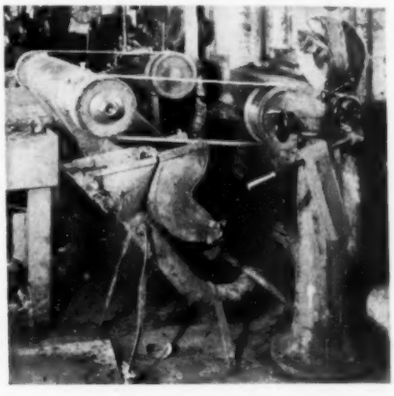
The weight of the motor and the counter balancing cable and weights make operation of the machine, according to the manufacturer, smooth, light and easy to handle and it does not tire the operator. The machine is usually swung about 3′ from the floor and is especially adapted for work too large or unwieldy to be lifted to a wheel mounted on the usual floor stand. The usual clearance between floor and underside of the motor carriage is 3′ 9″. The overall horizontal length is 6′ 10″, width 2′ 2″. Safety guards are furnished with the machine.

The drawing and the photograph shown herewith illustrate the construction and operation of the lathe.

Back Stand Idler for Belt Polishing

L. G. Evans & Co., 737 S. Western Ave., Chicago, Ill., are distributors of the "Niederst" back stand idler. This equipment enables belt grinding and polishing to be done by using a polishing lathe and set up wheel. The abrasive belt is connected between the user's polishing lathe and the idler, and large savings in buffing and polishing costs are claimed.

Some of the advantages, according to the manufacturer, of the use of belt polishing are longer life of abrasive medium, no glazing, quick changing of various grit sizes, uniform grit, lower work cost and more uniform finish. In addition, the use of the belt eliminates wheel balancing and the use of loose grain and glue pots for setting up wheels.



Back stand idler for belt polishing

The idler is a totally enclosed gun carriage type mechanism, providing all necessary horizontal and angular adjustments of the idler pulley; all adjustments have positive locks; lightweight standard idler pulley 10 inch diameter by 4 inch face; 6 inch face can be furnished on special order; idler pulley lubricated for life. Can be furnished in floor model or wall bracket model. Weight of floor model is 125 lb.; wall bracket, 75 lb.

Belts with a wide range in length and grit size are available.

Cowles METAL CLEANERS
Geared to YOUR DEFENSE JOB
YOUR JOB
Cowles TECHNICAL SERVICE

★COWLES METAL CLEANERS are designed and installed to fit your job and do your cleaning work at *top speed 24 hours a day*—while your production men are speeding up other operations.

There is a Cowles Cleaner for every cleaning job—armor plate to shell fuses—stainless steel to die castings.

Let COWLES show you how

COWLES CLEANERS
Save MAN POWER
Save PRODUCTION HOURS

THE COWLES DETERGENT CO., Metal Cleaner Department, Cleveland, Ohio

MAIL THIS COUPON TODAY

THE COWLES DETERGENT CO., Metal Cleaner Department, 7016 Euclid Ave., Cleveland, Ohio
What can you do for us on the following type of cleaning?

Company
Street & No.
City & State
Signed
Title or Department

Manufacturers' Literature

Arc Welders

Hobart Brothers Co., Troy, Ohio, have issued a new 38-page catalog describing the company's complete line of arc welders and accessory equipment. Photographs in color illustrate various models of equipment and many applications of this equipment are pictorially shown and described.

Air Operated Controllers

The Brown Instrument Co., Philadelphia, Pa., has just issued their new catalog No. 8903 entitled, "Brown Air Operated Con-

trollers for Temperature, Pressure, Flow, Liquid Level, Humidity". This 36-page catalog describes the various types of air operated controllers discussing how, why, when and where these instruments could be used. Photographs depict typical installations and schematic drawings showing the principles of operation.

Aluminum Melting Furnaces

Bulletin No. 300 describes and illustrates various gas fired aluminum melting furnaces sold by *Fisher Furnace Co.*, 1740 N. Kolmar Ave., Chicago, Ill. Constructional details, specifications and capacities of these furnaces are given.

Back Stand Idler for Polishing

L. G. Evans & Co., 737 S. Western Ave., Chicago, Ill., in a 4-page bulletin describe and illustrate the "Niederst" back stand idler for use with buffing lathes for belt polishing. Various uses for the belt polishing set up are shown and specifications and advantages of the use of the back stand idler for belt polishing are given.

Copper Oxide Rectifiers

"Copper-Oxide Rectifiers for Electroplating" is a 14-page catalog issued by the General Electric Company, Bridgeport, Conn., describing the company's rectifiers for electroplating. The 300 and 500 ampere rectifiers are described and illustrated as well as the voltage regulator. These units can be used in supplying greater amperage or voltage by connecting various units in either series or parallel. Information on efficiency, maintenance and construction of these rectifiers is given and photographs illustrate typical installations of units in various plating shops.

Grinding Carbide Tipped Tools

Norton Co., Worcester, Mass., have recently published a handbook on reconditioning and sharpening single point cemented carbide tools rapidly and economically. The book is wire bound and contains 64 pages. Section I discusses "Metal Bonded Diamond Wheels", Section II "Resinoid Bonded Diamond Wheels", Section III "Green Crystolon Wheels", Section IV "General Information". Many photographs and drawings amplify the text.

Heat Treating Baths

The A. F. Holden Co., New Haven, Conn., have recently published an 8-page booklet describing the company's heat treating baths and heat treating equipment. These baths include those for normalizing of forgings, continuous salt bath hardening, wire patenting, direct process annealing, silver soldering, austempering, descaling and bright tempering. The operating temperature ranges and uses for the various baths are described. In addition, capacities and illustrations of the company's pot furnaces are given.

High Pressure Steam Cleaners

Homestead Valve Mfg. Co., Coraopolis, Pa., have recently issued an 8-page catalog describing their "Hypressure Jenny" steam cleaners. Various applications of these cleaners are illustrated and described, and specifications are given for the various types of pressure cleaning equipment. The principle of operation of the cleaners is clearly illustrated by a cross sectional drawing. These cleaners can be used for motor and chassis cleaning of automobiles, cleaning for repainting of parts for finishing and walls, floors and various large equipment.

Motor Generators

Motor Generator Corp., Box MG-1, Troy, Ohio, have issued a 4-page pamphlet describing their latest models of motor generator sets for electroplating and anodizing. Several of the company's sets are illustrated and specifications are given for the same. The Motor Generator Corp. is a new company taking over the manufacture and sale of motor generators and automotive products formerly manufactured by Hobart Bros. Co., Troy, Ohio.

New Spring Alloys

A new booklet which reports in detail on the value of five different metals for spring purposes under conditions which involve exposure to corrosion as well as to high and low temperatures and other severe service has been published by The International Nickel Company.

Paste Solder

Wayne Chemical Products Co., 9440 Copeland St., Detroit, Mich., have issued a folder describing their new soldering process which involves the use of paste solder, in which is incorporated a flux. Typical examples of the use of the solder are men-

Here's the latest Metal Cleaning Data you've been looking for!

IT'S YOURS FOR THE ASKING

Here is the latest data on cleaning shells, shell cases, cartridges, fuse parts and all other munitions. This handbook also covers the most recent developments in metal cleaning for the myriad other metal parts and units needed for the defense program. You'll find plenty of time-saving, money-saving ideas in this book. Just write us for your copy.

MAGNUS CHEMICAL COMPANY

Manufacturers of Cleaning Materials, Industrial Soaps, Metallic Soaps, Sulfonated Oils, Emulsifying Agents and Metal Working Lubricants.

11 South Avenue Garwood, N. J.

Magnus CLEANERS

WYANDOTTE

★ Metal Cleaners

★ Service

TEAM UP FOR DEFENSE!

Wyandotte Products are being used for the following problems:

1. Electrolytic or spray cleaning of *aluminum alloy castings* on high-speed production basis after machining and prior to *anodizing.*
2. Electrolytic cleaning of *steel* after machining prior to *hard chrome* and *cadmium.*
3. Power washer cleaning of *airplane motors* prior to and after assembling.
4. Tank cleaning of *brass shell cases* during the numerous operations of *drawing, tapering* and *annealing.*
5. Power washer cleaning of *machine gun parts* prior to finishing.
6. Power washer cleaning of *steel shells.*
7. Power washer cleaning of *screw - machine aluminum and brass munition parts.*
8. Power washer cleaning *manganese steel helmets* prior to painting.

Phone or Wire

THE J. B. FORD SALES COMPANY

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Wyandotte PRODUCTS

SERVICE REPRESENTATIVES IN 88 CITIES

THE J. B. FORD SALES COMPANY, WYANDOTTE, MICHIGAN

tioned and the correct method of application is graphically shown. Advantages of the paste solder are outlined.

Polishing Wheel Adhesive

Lea Mfg. Co., Waterbury, Conn., have just issued a 4-page folder describing "Ad-Lea-Sive," which is the company's glue base adhesive for use in bonding polishing grain to the polishing wheel. The folder describes methods for the use of the adhesive and eight specific advantages are outlined. Some of these advantages include high penetrating quality, high bonding strength, good flexibility, faster setting, longer wheel life and high resistance to bacterial action. The material is shipped in the form of a jelly-like substance in 1 gallon, 5 gallon and 50 gallon containers.

Rectifiers for Electroplating

General Electric Co., Bridgeport, Conn., have issued an 18-page booklet, their No. 52-4117, which describes General Electric copper oxide rectifiers for electroplating. Typical installations are shown and the booklet also contains a brief history of the development of copper oxide rectifiers and their application to electroplating.

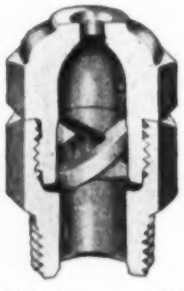
Scale and Rust Removal

Oakite Products, Inc., 18 Thames Street, New York, have issued a revised third edition of their illustrated 20-page booklet describing Oakite Compound No. 32. This is a specially designed material with reported high scale and rust removal properties to be used in de-scaling equipment and water-circulating processes. Various types of equipments de-scaled by the use of this compound are described.

For those interested in removal of scale or rust in connection with equipment operation or appearance can secure a copy of this publication by writing to Oakite Products, Inc.

Spray Nozzles

Spraying Systems Co., 4019-21 W. Lake St., Chicago, Ill., have issued catalog No. 21, describing and illustrating a complete line of spray nozzles for all industrial uses and contains many useful performance tables and data sheets. A copy may be obtained by writing to the company.



FULLJET . . . Full cone spray pattern, even distribution. Made of all metals.

SPRAY CLEANING . . will speed up your production

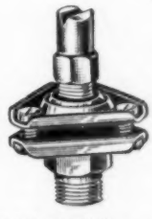
Nowadays when metal-finishing plants are working at full capacity, you owe it to yourself to check on your cleaning methods—spray cleaning is the fastest and surest method of cleaning and degreasing metal parts of any size and shape.

If you already are using spray-cleaning, check on your nozzles to see if they are working at full efficiency. Worn, corroded nozzles cut down production and waste cleaning fluid. It's cheaper to replace them with new, efficient Spraying Systems Nozzles.

Write for our new catalog!

SPRAYING SYSTEMS COMPANY

4039 W. LAKE STREET, CHICAGO, ILL.



FLAT SPRAY . . . Produces a flat, hard-hitting stream. Shown here in our adjustable joint for changing angle.

Thermocouples

Wheelco Instruments Co., Harrison & Peoria Sts., Chicago, Ill., have issued their bulletin No. S2-3 superseding No. S2-2, which is a 32-page book giving data on thermocouples. Specifications and drawings of the various alloy thermocouples available are given. Protecting tubes and standardized wire for thermocouples are included. Several pages are devoted to a description of the construction of thermocouples and various temperature-millivolt conversion charts are given for important thermocouples used in temperature measurement. A temperature conversion table from Fahrenheit to Centigrade, and data on fractional and decimal equivalents are also given.

Washing Machines

The Alvey-Ferguson Co., Oakley Sta., Cincinnati, Ohio, have recently issued an illustrated 4-page folder describing seven washing machines recently developed to solve various washing problems. These machines include those for washing tools, ball bearing parts, diesel motor blocks, hardened gears and chromium plated parts. The advantages claimed for the construction of the Alvey-Ferguson machines are outlined and special drawings illustrate the method of spraying the parts to be cleaned.

Wire Rope

The Macwhyte Wire Rope Co., Kenosha, Wis., has just issued a new catalog entitled "Macwhyte Wire Rope" which lists more than 1,000 wire ropes. It is sectionalized for quick reference with a tabbed index and table of contents for each section. Sixty pages of general information are included in addition to the pages of tables.

A Reminder

PERIODIC TREATMENT OF BRIGHT NICKEL PLATING SOLUTIONS WITH NUCHAR ACTIVE CARBON GIVES THESE ADVANTAGES:

- ✓ IMPROVES QUALITY OF PLATING
- ✓ AVOIDS THE NECESSITY OF EXTRA BUFFING
- ✓ ELIMINATES A TENDENCY TO BRITTLENESS IN PLATED NICKEL

ACTIVE NUCHAR CARBON

INDUSTRIAL CHEMICAL SALES

DIVISION WEST VIRGINIA PULP & PAPER COMPANY

230 Park Avenue - - - New York

Communications

Analysis of Tin Solution

WRIGHT AERONAUTICAL CORPORATION

PATERSON, N. J.

September 10, 1941.

Dear Dr. Meyer:

We have been using the volumetric method for determining the tin content of our alkaline tin solutions as outlined in the Plating and Finishing Guidebook with a slight modification which may be of interest to your readers. Instead of using a saturated sodium bicarbonate solution to evolve carbon dioxide gas to prevent oxidation of the tin prior to titration, we add dry ice. After the reduction is complete, a small piece of dry ice is added to the solution. During the rapid evolution of gas the glass rod with the nickel strip is washed and removed. Dry ice is then added in quantity. Too much must not be added or ice forms in the flask. When the solution is cold it is titrated as usual with iodine solution. The use of dry ice has the advantage of eliminating the sodium bicarbonate solution seal with its delivery tube, and also affording very rapid cooling which serves to cut down any oxidation by air, which is most rapid while the solution is warm.

We have been using this method over a period of several months with great success.

Yours truly,

Clifford Struyk,

Materials Laboratory.

Determining Area of Work

Sept. 15, 1941.

Dr. Walter Meyer, Editor
Metal Finishing
New York City.

Dear Sir:

In the September issue of *Metal Finishing*, I noticed a letter by P. F. Atwood of the Eagle Lock Co., in connection with the measurement of surface areas of stamped parts.

We use a simpler method than tracing a complicated shape on cross section paper, namely, weighing a piece of a few pieces if they are small in size, and looking up the square feet per lb. for that particular gauge of sheet in an engineer's handbook. From the two figures, the area of the article can be computed very readily. One must remember when using sheet metal tables that the area per lb. must be multiplied by two for plating purposes since both sides of the sheet are plated.

This method is limited to application where there is no appreciable reduction in gauge due to forming or where there is no large number of holes in a sheet of heavy gauge. In other words, it can be used for the great majority of stampings.

Cordially yours,

Nathaniel Hall.

Associations and Societies

Plating and Rustproofing Association of Michigan

The 1941 annual summer stag party of the Plating and Rustproofing Association of Michigan was held at Gowanie Golf Club at Mt. Clemens, Mich., on Saturday, September 13.

CHROMIC ACID

99.75% PURE

With two complete, independent plants at Jersey City and Baltimore, and its own supply of the basic raw material Chrome Ore from company owned and operated mines. Mutual is the world's foremost manufacturer of Chromic Acid.

BICHROMATE OF SODA
BICHROMATE OF POTASH

Mutual Chemical Co of America
270 MADISON AVENUE, NEW YORK

It was well attended by the industry as a whole and by many non-member companies, as well as a large portion of the suppliers in the local industry. About 40 people played golf during the afternoon and approximately 80 were at the dinner held at 7 o'clock in the evening.

Many prizes were awarded and a lavish entertainment was provided for the members and guests. Movies were taken of the meeting and will be shown at the Association's regular October dinner.

Eighteenth Exposition of Chemical Industries

The Eighteenth Exposition of Chemical Industries will be held in Grand Central Palace, New York, December 1-6, and this Exposition is of particular importance because of the need for substitution and use of new materials.

More than 300 exhibits from all parts of the country will be shown in the Grand Central Palace.

American Electroplaters' Society

Philadelphia Branch

The Branch will hold its annual meeting and banquet on November 1st instead of the Saturday preceding Thanksgiving as was done in past years.

The session will be held at the Broadwood Hotel, corner of Broad and Wood Sts., Philadelphia.

The educational session will start at 2:00 P.M. with the following speakers and subjects:

1. *Dr. Wm. Blum*, National Bureau of Standards, Washington, D. C.—"The Effect of Metal Shortages on the Plating Industry".
2. *Dr. Jesse E. Stareck*, Technical Director, Electrocolor Div., United Chromium, Inc., Waterbury, Conn.—"Unichrome Alkaline Copper".
3. *Robert Sizelove*, Research Chemist, Frederick Gumm Chemical Co., Inc., Kearny, N. J.—"Changes in Cleaning Methods Due to Defense Problems".
4. *Leroy Sullivan*, Divine Bros. Co., Utica, N. Y.—Subject to be announced.

The banquet will start at 7:00 P.M., with dancing to follow. Tickets: $3.00. *George Gehling*, 5001 Tulip St., Philadelphia, is chairman of the Banquet & Ticket Committee, and *Ray Eckert*, Fox Products Co., Philadelphia, is chairman of the Meeting Committee.

Newark Branch

Using the "Information Please" technique, the Newark Branch will discuss the electroplating and finishing of metals at their next meeting, to be held at the Robert Treat Hotel, Newark on October 17. Special attention will be devoted to problems arising from the national defense situation, which is causing a severe shortage of many kinds of metal finishing materials.

The principals who will take part in the discussion include *Dr. Walter R. Meyer*, Editor of *Metal Finishing* and *Dr. C. L. Mantell*, consulting chemical engineer, and *Mr. G. Klinkenstein*, vice-president and technical director of Maas & Waldstein Company, Newark.

Personals

E. Candee and R. Crane to be Honored

Ellsworth Candee, president of the American Electroplaters' Society and chemist of the Metal Hose Branch of American Brass Co., Waterbury, Conn., and *Richard P. Crane*, vice-president of Lea Mfg. Co., Waterbury, Conn., and chairman of the International Fellowship Club, are to be honored by a dinner, Saturday, October 25th, at the Hotel Elton, Waterbury, Conn., by the Waterbury Branch of the A.E.S. The dinner will start at 7:30 P.M. and *Joseph Downes*, Remington-Rand, Inc., Ilion, N. Y., will be Master of Ceremonies. Several speakers and an interesting entertainment is being arranged.

Tickets to the dinner, which is stag, are $3.00 per person and tickets can be secured from *Spencer L. Henn*, of Apothecaries Hall Co., Waterbury, Conn. The sale of tickets will close October 18th. Friends of Messrs. Crane & Candee are invited to attend.

Strow Joins MacDermid

MacDermid, Incorporated, of Waterbury, Connecticut, manufacturers of compounds and processes for the cleaning of basis metals, announces the appointment of *Henry A. Strow* as Chief Chemist.

Mr. Strow, after graduation from Purdue University, was employed by the Udylite Corporation as research chemist, and more recently as Maintenance Service Engineer of Detroit Transmission Division of General Motors Corporation, Detroit.

C. R. Allen, New England Representative of American Buff Corp.

Charles R. Allen

Charles R. Allen, Wethersfield, Conn., buffing and polishing engineer, has become New England representative of *American Buff Corporation*, 228 N. Clinton St., Chicago, Ill., according to *Ben Sax*, president. Mr. Allen is well versed in the various technical aspects of polishing and buffing, and is also well known in this industry.

Meyer Roter, former superintendent of the metal finishing department of *E. F. Collite Co.*, Trenton, N. J., has moved to Los Angeles and has announced his decision to locate permanently in Southern California. He is a member of Newark Branch, A.E.S., and plans soon to have his membership transferred to Los Angeles Branch.

Emmette R. Holman, chief chemist of Turco Products, Inc., Los Angeles, reports the addition to the Turco research staff of *James ApRoberts*, who formerly was associated with *Lockheed Aircraft Corp.*, Burbank, Calif. In his new duties Mr. ApRoberts will work on chemical analysis of chemical solutions, water analysis, plating and metal finishing problems.

Conrad Corda, formerly of Jersey City, N. J., has become associated with Fitzgerald Mfg. Co., Winsted, Conn., as foreman plater and chemist. Mr. Corda is a member of the Newark Branch of the American Electroplaters' Society. His home address will be Torrington Road, Winsted.

The Bristol Company, Waterbury, Conn., announce the transfer of *H. R. Bristol* from their Chicago Office to their Boston Office. Mr. Bristol has had experience in both the Engineering and Sales Departments of The Bristol Company. He will make his headquarters at the Boston Office, which is located in the Consolidated Bldg., 250 Stuart Street.

Ernest E. Murray, president of the *Murray-Way Corp.*, Detroit, manufacturers of buffing and polishing materials, was in Los Angeles on a week's business trip during the early part of September. It was Mr. Murray's first visit to Southern California. *Alex Regmunt*, foreman of the plating department of *U. S. Spring & Bumper Co.*, Los Angeles, served as Mr. Murray's guide.

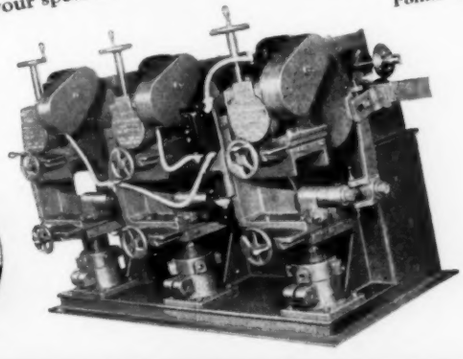
The ACME METHOD of Tube and Pipe POLISHING

✓ INCREASES PRODUCTION
✓ INSURES BETTER FINISH
✓ at Lower Cost

Polishing costs take a licking all along the line when this Acme 3-Wheel Automatic bites into a tough job of tube or pipe finishing. It gives a three-way savings by performing three operations in one pass through the machine. Adjustable feed speeds from 0 to 20 or more feet per minute and compensating adjustments for tube size and wheel wear meet every production and finish requirement.

Investigate the advantages the Acme Method has to offer you on an application to meet your specific problem. Write Acme—no obligation.

Type T-3
3-Wheel Automatic Polishing Machine



SPECIAL MACHINERY amc AUTOMATIC BUFFING MACHINES

ACME Manufacturing Co.
1642 HOWARD ST. • DETROIT, MICH.
Builders OF AUTOMATIC POLISHING AND BUFFING MACHINES FOR OVER 25 YEARS

New Books

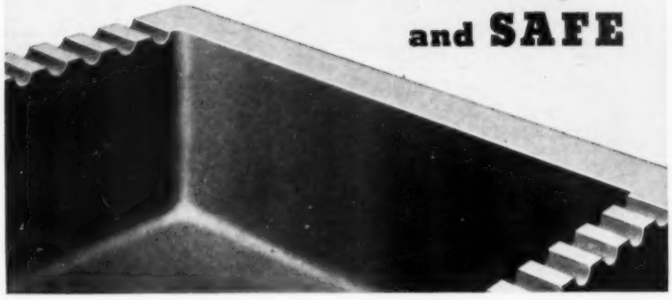
Active Carbon: The Modern Purifier. By John W. Hassler. Fourth edition, revised and enlarged. Published by Industrial Chemical Sales Division, West Virginia Pulp & Paper Co., New York. Size 6″ x 9″; 152 pages. Copies of the book are available free, to scientific, technical and educational organizations, as well as to consulting and industrial research laboratories.

This fourth edition follows the spirit of content of the earlier editions.

The text deals primarily with the so-called decolorizing type of active carbon, and no discussion is made of certain applications for which the gas adsorbent type active carbons are especially adapted.

The book can be considered as consisting of six general divisions. The first division, Chapter I, is a general approach and describes what active carbon will accomplish and how it is used. The second division, Chapters II to XIII, covers a more detailed description of the application to various products. Apart from sugar and water—very little information on the industrial use of active carbon is found in literature. Therefore, it has been necessary to depend on direct contacts for the information contained in this division. A third division, Chapters XIV to XVI which reviews certain basic principles is provided for the research chemist who may be con-

Acid-Proof and SAFE



Corrosion problems do not exist for the manufacturer who standardizes on General Ceramics Chemical Stoneware. He knows that his chemical handling equipment is completely impervious to all chemicals used in metal finishing; and he has no fear of possible leakage and consequent injuries to employees or damage to property. General Ceramics stoneware is clean and easy to keep clean. It eliminates all danger of contamination of products or materials. It is flexible of design and therefore readily adaptable to many special as well as the usual chemical handling requirements. The first cost is low and the over-all cost still lower as compared with other materials of construction. Write for bulletins.

GENERAL CERAMICS COMPANY

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NEW YORK, 30 Broad Street; BUFFALO, 306 Jackson Building; SAN FRANCISCO, 598 Monadnock Building; CHICAGO, 208 South LaSalle Street; SEATTLE, 1411 Fourth Avenue Building; LOS ANGELES, 415 South Central Avenue; SPOKANE, 1823 South Maple Street; PORTLAND, Railway Exchange Building; TACOMA, Tacoma Building; MONTREAL, Canada Cement Building; TORONTO, Richardson Agencies, Ltd., 454 King Street, West.

CHEMICAL STONEWARE

PIPE, VALVES, FILTERS, PUMPS, EXHAUSTERS, ETC.

sidering an application in a new field or an improvement in the application to existing fields. A fourth division, Chapter XVII discusses methods of evaluation and a fifth division covers a bibliography of the literature that has appeared on the general subject of adsorption as related to active carbon.

Business Items

W. Green Electric Co. Expand Manufacturing Facilities

W. Green Electric Co., 130 Cedar St., New York, have expanded their production and stock floor space over 400%, to take care of the increase in business in selenium type rectifiers. New precision machinery has been installed and the company is now operating 98% on defense work. To illustrate the type of rectifiers being made, sets recently in progress of manufacture on the floor ranged in capacity as follows: 25 amp., 6 volts; 20 amp., 24 volts; 60 amp., 12 volts; several 1000 amp., 6 volts; 900 amp., 12 volts and 3000 amp., 6 volts.

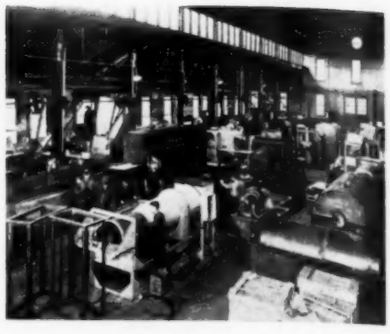
Equipment for various types of power supply was being made. Rectifiers were being made for the following sources of primary current: 110 volt, single phase; 220, 260 and 440 volts, 60 cycle, 3 phase; and 440 volt, 25 cycle, 3 phase.

N. Ransohoff, Inc. Expands Facilities

N. Ransohoff, Inc., Cincinnati, Ohio, have recently taken over 16,000 sq. ft. of manufacturing space of the Stacey Manufacturing Company's plant in Elmwood Place. The Ransohoff company was formed in 1929 by *Nathan Ransohoff* and *Julius W. Freiberg*, and manufacture a variety of automatic machines for washing, tumbling, burnishing, pickling and drying operations of metal parts.

Today the company is turning its efforts towards production of such machines for defense industries. For example, many of the above mentioned operations are necessary in the manufacture of ammunition for small arms. Machines for washing metal parts are made in two types. One is a drum type with continuous metal grooves along which the parts pass through the various solutions. For larger articles, a conveyor type machine carries the parts on a level surface through the cleaning and rinsing operations.

R. C. Wigger is assistant to the president, and *John Sterwerf* is superintendent. *W. R. Niesslein* is in charge of the drafting room.



General view of the interior of N. Ransohoff, Inc. plant showing workmen assembling various type equipment for metal treating.

Another view in plant.

J. P. Hoxie, V. E. Fay and *R. S. Reischling* of Los Angeles have organized the *Phillips Bronze Corp.*, with capital stock of $50,000.

B. & F. Engineering Co., 7612 South Vermont Ave., Los Angeles, is building an addition to its machine shop and metal treating room.

Acro Metals Corp. is the name of a new firm organized at Los Angeles by *J. G. Hiestand*, of Los Angeles, and *H. H. Corbett*, and *J. C. Corbett* of Sunland, Calif.

Sampson Motors, 6031 South Gramercy Place, Los Angeles, is erecting a new unit of 8000 square feet of floor space at 1950 West 62nd St.

G. B. Hogaboom, Jr. and Co., 352 Mulberry St., Newark, N. J., have announced that *P. A. Florio* has joined the company and will be engaged in the analysis of solutions and testing of deposits.

New Departure Division, General Motors Corp., Bristol, Conn., steel balls, ball bearings, etc. will expand plant for production of aircraft parts for the government, which will furnish fund of about $2,442,000 for purchase of machinery, equipment and other facilities through Defense Plant Corp., Washington. The company operates a grinding and pickling department.

Trojan Lacquer Co. is erecting a 10,000 sq. ft. building at 653 South Anderson St., Los Angeles, to provide increased facilities for the manufacture of lacquer and paint.

Hard Chrome Engineering Co., 1051 East Slauson Ave., Vernon, Calif., has announced plans for erecting a 5,800 sq. ft. plant at 1717 East Slauson Ave. for chromium plating of aircraft equipment and pneumatic tools.

The Washington Eljer Co. has work under way on a two-story, 15,000 sq. ft. addition to its Pottery Division plant at 4200 South Alameda St., Los Angeles, to provide enlarged facilities for the manufacture of vitreous china plumbing fixtures.

Precision Metal Products has been organized at Burbank, Calif., by John Castle, who has established plant and offices at 129 East Providencia St.

Corrosion Control Corp. have announced the removal of their office on September 15th from 212 Wright St., Newark, N. J., to 34 Smith St., Norwalk, Conn. The executive offices, laboratory and entire manufacturing equipment will be located in the company's own building in Norwalk. This is stated to greatly improve production facilities and more modern research laboratories are available for development and service. The company manufactures "Coresco" resistant coating.

M. B. Austin Co., 108 S. Desplaines St., Chicago, Ill., electrical conduits and other electrical products, has asked bids for a new one and two story plant in Northbrook section, about 100 x 160 feet. Cost close to $80,000 with equipment. The following departments are operated: tumbling, degreasing (solvent), plating, hot galvanizing, enameling and japanning.

Uniloy Accessories Corp., 208 Erie Ave., Lancaster, N. Y., oxygen regulators and parts, has begun work on one-story addition, about 10,000 sq. ft. of floor space, for production for British Government. Cost close to $45,000 with equipment. The following departments are operated: sand or shot blasting, buffing, degreasing (solvent), anodizing, metal spraying and lacquering.

Barrett Equipment Co., 2101 Cass Ave., St. Louis, Mo., brake equipment, tools and other mechanical products, has let general contract for a one-story addition, about 50 x 130 ft. Cost over $25,000 with equipment. The company operates the following departments: grinding, tumbling, polishing, degreasing (solvent), lacquering and painting.

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Save Time By Sending Your Solutions To Us For Analysis. Immediate Accurate Report By Air Mail.

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Nickel, Chlorides
Boric Acid, pH
COPPER SOLUTIONS
Copper, Free Cyanide
Carbonates, pH
ACID COPPER
Copper, Sulfuric Acid
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Free Cyanide,
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BRASS SOLUTION
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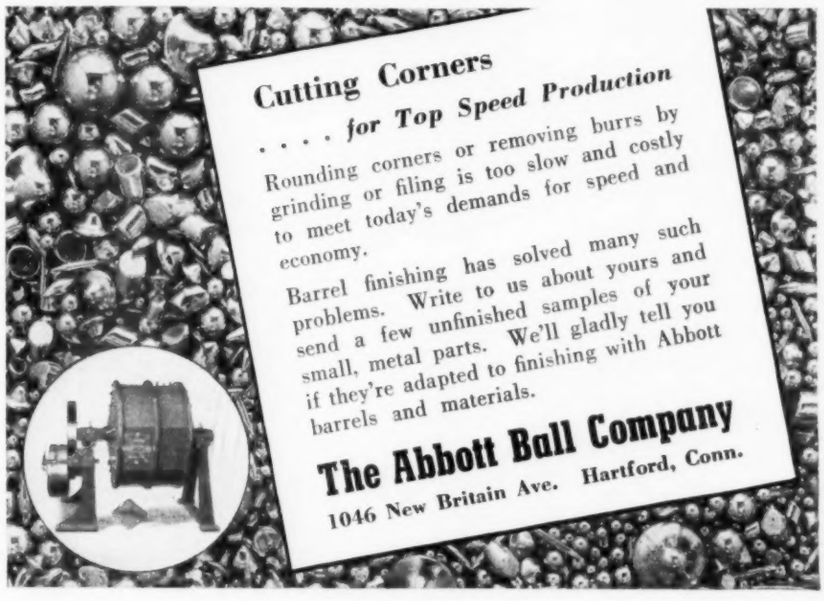
Cutting Corners
. . . . for Top Speed Production
Rounding corners or removing burrs by grinding or filing is too slow and costly to meet today's demands for speed and economy.
Barrel finishing has solved many such problems. Write to us about yours and send a few unfinished samples of your small, metal parts. We'll gladly tell you if they're adapted to finishing with Abbott barrels and materials.
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1046 New Britain Ave. Hartford, Conn.

STRIP COPPER PLATE
from
Zinc Die Castings
with
McKEON'S
"Liquid Sulphur"
TRADE MARK REG'D

It is *"THE OXIDIZING AGENT OF TODAY", you know.* Insures Uniform Results—(Whether for stripping or oxidizing.)

SAMPLE FREE SERVICE

SULPHUR PRODUCTS CO. Greensburg, Pa.

("Let's Go" to Grand Rapids with A.E.S. in '42)

HAVEG TANKS

For pickling . . . plating . . . processing . . . storage . . . OK for hydrochloric . . . hydrofluoric . . . sulphuric up to 50% . . . *UNAFFECTED* by rapid temperature changes . . . can be used continuously up to 265°F. a molded seamless plastic . . . it's tough!

Write HAVEG CORP., Newark, Del. for Bulletin F-28.

Perma-Line Rubber Products Co. are moving into new and larger quarters at 1840-42 N. Damen St., Chicago, Ill. The company does every type of rubber lining for plating tanks, acid fittings, buckets, etc. The move to new quarters was necessitated by the large increase in business, which made the old quarters at 2225 W. Grand Ave., Chicago, inadequate.

Spraying Systems Co., 4021 W. Lake St., Chicago, Ill., manufacturers of spray nozzles and equipment exclusively, are now enlarging their plant and more than doubling their manufacturing capacity. This move is made necessary by the wide-spread growth in the sales of the company's nozzles throughout the entire field of industry.

Acco Products, Inc., 24-02 39th Ave., L. I. City, N. Y., metal files, paper clips and other metal specialties, has let general contract for a new two-story plant, about 75' x 125', at 39-08 24th Street, L. I. City. Cost over $65,000 with equipment. The firm operates the following departments: degreasing (solvent), enameling and painting.

The Keystone Carbon Company has just completed a large addition to their factory in Saint Marys, Pa. The new wing will be used for the manufacture of brushes and porous bronze bearings. A considerable increase in production is predicted.

The company has also laid the foundation for another large plant addition which will house new equipment for making their negative temperature coefficient resistors.

Foxboro Company, Foxboro, Mass., have announced a new address for their Cincinnati, Ohio, office. This address will be 607 American Building, Walnut St. and Central Parkway.

Andrew W. Liger has joined the research staff of *Battelle Memorial Institute*, Columbus, Ohio. He has been assigned to the division of electrochemical research.

Mr. Liger was formerly associated with the W. B. Jarvis Company, Grand Rapids, Michigan. He is a graduate of Michigan College of Mining and Technology and is a member of the American Electroplaters' Society.

PERMAG Cleaning Compounds

—for cleaning Metals used in Defense Production Work

At aeroplane factories, ship yards, metal fabricating plants or wherever metal cleaning is done PERMAG Cleaning Compounds are used.

Fast efficient action, low cost and thoroughness of PERMAG Cleaners make them ideal for work in the National Defense Program.

When you have a cleaning problem send for the Magnuson Research Service for help in reaching a solution.

MAGNUSON PRODUCTS CORPORATION

Manufacturers of Specialized Scientific Cleaning Compounds for every Industrial Purpose.
Representatives from Coast to Coast. **Main Office, 50 Court Street, Brooklyn, N. Y.** Warehouses in principal cities of U. S.
IN CANADA: Canadian PERMAG Products Ltd., Montreal and Toronto

Supply Prices, September 26, 1941

Anodes

Prices are f.o.b. shipping point on quantities of from 500-999 lbs. for copper, brass and zinc. For nickel, prices are for quantities from 500-2,999 lbs.

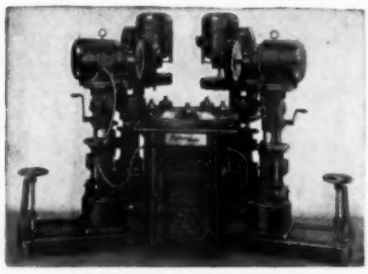
COPPER: Cast, elliptical, 15" and longer ..... .25⅛c. per lb.
Electrolytic, full size, .22⅞c; cut to size .22⅞c. per lb.
Rolled, oval, straight 15" and longer .23¼c. per lb.; curved ..... .24¼c. per lb.
BRASS: Cast, 80-20, elliptical, 15" and longer .... .23⅝c. per lb.
ZINC: Cast, 99.99, 16" and over ..... 15¼c. per lb.
NICKEL: 95-97 cast, elliptical 46c. per lb., 99% plus cast 47c.; Rolled, depolarized ..... 48c. per lb.
SILVER: Rolled, .999 fine per Troy oz. ..... 38c. per oz.

Chemicals

These are manufacturers' quantity prices and based on delivery from New York City.

Acetone, C.P., drums, l.c.l.	lb.	.09-.10
Acid, Boric tech., 99.5% gran., bbls.	lb.	.061⅝
Chromic, 99%, 100 lb. drums, l.c.l.	lb.	.18¼
Hydrochloric (muriatic) Tech., 20°, carboys, wks.	lb.	.0270
Hydrochloric, C.P., 20°, bottles	lb.	.19
Hydrofluoric, 30% bbls.	lb.	.06-.06½
Nitric, 36°, carboys 1-9, wks.	lb.	.0595
Nitric, 42°, carboys 1-9, wks.	lb.	.0745
Oleic (Red Oil), distilled, drums	lb.	.12-.13
Oxalic, bbls. l.c.l.	lb.	.14½
Stearic, distilled, double pressed, bags	lb.	.14¼-.15¼
single pressed, bags	lb.	.13¾-.14¾
triple pressed, bags	lb.	.17-.18
Sulphuric, 66°, carboys 1-9, wks.	lb.	.0245
Alcohol, Amyl, (Fusel oil, ref'd), l.c.l., drums	lb.	.17½-.19½
Butyl-normal, l.c.l., drums	lb.	.11½-.12½
Denat., S.D. #1, 190 pf., 1-18 drms, wks.	gal.	.35½
Diacetone, tech., drums, l.c.l.	lb.	.11½-.12½
Methyl, (Methanol), 95%, drums, l.c.l.	gal.	.48½
Propyl-Iso, 99%, drums, l.c.l.	gal.	.43-.47
Propyl-Normal, drums, wks.	gal.	.70
Alum, ammonia, granular, bbls., works	lb.	.04
Potash, granular, bbls., works	lb.	.0425
Ammonia, aqua, 26°, carboys	lb.	.05¼
Ammonium, chloride (sal-ammoniac), white, granular, bbls., wks.	lb.	.0445
Sulphocyanide (thiocyanate), pure, crystal, kegs	lb.	.55
Sulphocyanide (thiocyanate), tech., kegs	lb.	.40
Antimony Chloride (butter of antimony), sol., carboys	lb.	.17
Barium Carbonate, ppted., bags, l.c.l., works	lb.	.03
Benzene (Benzol), 90%, drums, works	gal.	.19
Butyl Lactate, drums	lb.	.235
Cadmium Oxide, l.c.l., bbls.	lb.	.95
Calcium Carbonate (Ppted. chalk), c.l., wks.	lb.	.02¾
Carbon Bisulfide, l.c.l., 55 gal. drums	lb.	.06¼
Carbon Tetrachloride, l.c.l., drums	gal.	.80
Chromic Sulphate, scale, 100 lb. drums	lb.	.45
Cobalt Sulphate, drums	lb.	.71
Copper, Acetate (verdigris), bbls.	lb.	.26
Carbonate, 52-54%, bbls.	lb.	.16½
Cyanide, Tech., 100 lb. bbls.	lb.	.34
Sulphate, 99%, crystals, bbls., 1-5	lb.	.0535
Cream of Tartar (potassium bitartrate), gran., kegs	lb.	.58½
Crocus Martis (iron oxide) red, bbls.	lb.	.03¼
Dibutyl Phthalate, drums, l.c.l.	lb.	.195-.205
Diethylene Glycol, drums, l.c.l., works	lb.	.155
Dextrin, white, bags, F.O.B. Chicago	lb.	.0395
Emery (Turkish)	lb.	.08
Ethyl Acetate, 85%, l.c.l., drums, works	lb.	.09-.10
Ethylene Glycol, l.c.l., drums, works	lb.	.15½-.18½
Monoethyl ether, dms., l.c.l., wks.	lb.	.125-.155
Gold, Chloride, yellow, bottles	oz.	$19.25
Cyanide, potassium 41%, bottles, wks.	oz.	$14.20-$14.95
Gum, Arabic, white, powder, bbls.	lb.	.27-.30
Hydrogen Peroxide, 100 volume, carboys	lb.	.16-.18½
Iron Sulphate (Copperas), cryst., bbls., 1-4 wks.	lb.	.02
Lead, Acetate (Sugar of Lead), crystals, bbls.	lb.	.12½
Oxide (Litharge), com., powdered, bbls.	lb.	.08¼
Magnesium Sulphate (Epsom Salts), tech., bbls.	lb.	.018
Mercury Bichloride (Corrosive Sublimate), crys.	lb.	$2.39
Mercuric Oxide, tech., red, powder, bbls.	lb.	$3.11
Nickel, Carbonate, dry, bbls.	lb.	.36-.36½
Chloride, bbls.	lb.	.18-.20
Salts, single, 425 lb. bbls.	lb.	.135-.145
Salts, double, 425 lb. bbls.	lb.	.135-.145
Paraffin, refined, bgs., 123-125 a.m.p., c.l.	lb.	.057
Perchlorethylene, drums, l.c.l.	lb.	.08½
Phosphorus, red, cases	lb.	.44
yellow, cases	lb.	.23-.25
Potash, Caustic, 88-92%, flake, drums, works, c.l.,	lb.	.07
Potassium, Bichromate, crystals, casks	lb.	.10
Carbonate (potash) calc., wks. drums		.06¾
Cyanide, 94-96%, dom. dms., wks.	lb.	.55
Pumice, ground, 1½ F. & coarser, bbls., wks.	lb.	.04¼
Quicksilver (Mercury), dom. 76 lb. flasks, net	flask	$192.-$195.
Rochelle Salts, crystals, bbls.	lb.	.44
Rosin, gum, B, bbls., dock	lb.	.0305
Silver, Chloride, dry, 50 oz. lots	oz.	.37½
Cyanide, 100 oz. lots	oz.	.33¾
Nitrate, 100 oz. lots	oz.	.26⅞
Sodium, Carb. (soda ash), light, 58%, bags	lb.	.0208
Cyanide, 96%, dom. 100 lb. drums	lb.	.15
Hydroxide (caustic soda) 76%, flake, l.c.l.	lb.	.0490
Hyposulphite, crystals, bags, wks.	lb.	.0250
Metasilicate, granular, 1-9 bbls.	lb.	.0335
Nitrate, rfd., gran., bbls., wks.	lb.	.029
Phosphate, tribasic, tech., bbls., wks.	lb.	.038
Pyrophosphate, anhydrous, bags, l.c.l.	lb.	.0560
Sesquisilicate, 1-9 drums	lb.	.0430
Stannate, drums	lb.	.365
Sulphate, anhydrous, bbls., works	lb.	.0215
Sulphocyanide, drums	lb.	.55-.65
Sulphur, Flowers, U.S.P., bbls., l.c.l. mine	lb.	.0335
Tin Chloride, crystals, kgs.	lb.	.39-.39½
Toluene (Toluol), 2°, ind., drums, works	gal.	.32
Trichlorethylene, drums, l.c.l., zone 1	lb.	.08½
Tripoli, air floated, bgs., c.l., wks.	ton	$26.00
Wax, Bees, white, bleached, slabs, 1-5 cases	lb.	.56
Bees, yellow, crude, Brazil, 100 lbs.	lb.	No stocks
Carnauba, refined, bags	lb.	.82
Montan, bags	lb.	No prices
Spermaceti, blocks	lb.	.24-.25
Whiting, precipitated, bags, l.c.l.	ton	$20.00
Xylene (Xylol), ind., returnable drums, works	gal.	.31
Zinc, carbonate, tech., bbls.	lb.	.20
Cyanide, 100 lb. kegs	lb.	.33
Chloride, tech., granular, drums, c.l., wks.	lb.	.08
Sulphate, crystals, bbls., l.c.l.	lb.	.039

•AUTOMATICALLY



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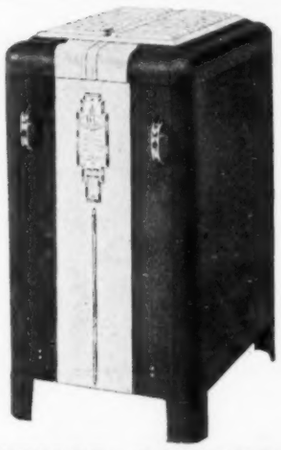

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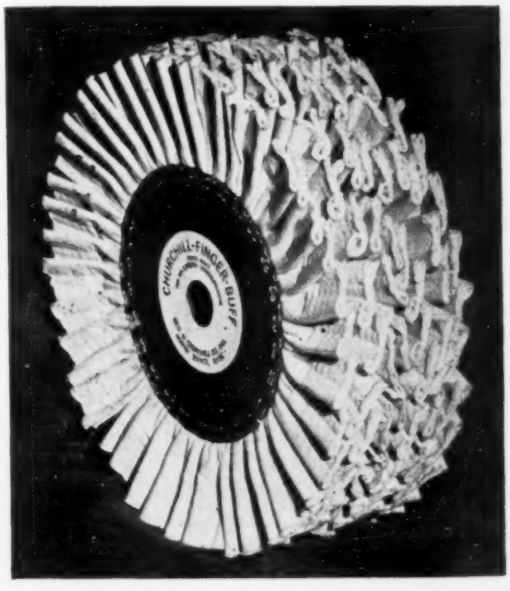

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